DOCUMENT RESUME

ED 283 430 HE 020 404

TITLE	The Impact of Converging Information Technologies. Proceedings of the CAUSE National Conference (Monterey, California, December 9-12, 1986).
INSTITUTION	CAUSE, Boulder, Colo.
PUB DATE	Dec 86
NOTE	586p.; Photographs may not reproduce well.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Viewpoints (120)
EDRS PRICE	MF03/PC24 Plus Postage.
DESCRIPTORS	*College Administration; College Planning; *Computer Oriented Programs; *Data Processing; Higher Education; Information Networks; *Information Technology; *Management Information Systems; *Microcomputers; Telecommunications; Users (Information)

ABSTRACT

Proceedings of a 1986 CAUSE conference on the impact of converging information technologies are presented. Topics of conference papers include: policy issues in higher education, planning and information technology, people issues in information technology, telecommunications/networking, special environments, microcomputer issues and applications, and managing academic computing. Some of the papers (with the authors) are: "Distributed Access to Central Data: A Policy Issue" (Eugene W. Carson); "Distributed Access to Central Data: The Cons" (Katherine P. Hall); "Overselling Technology: Suppose You Gave a Computer Revolution and Nobody Came?" (Linda Fleit); "Selling the President on the Computing Plan: Strategic Funds Programming" (John L. Green); "A Preliminary Report of Institutional Experience with MIS Software" (Paul J. Plourde); "Policy Issues Surrounding Decisions to Use Mainframe or Micros" (Phyllis A. Sholtys); "Alternative Models for the Delivery of Computing and Communications Services" (E. Michael Staman); "Converging Technologies Require Flexible Organizations" (Carole Barone); "Student Computing and Policy Issues" (Gerald McLaughlin, John A. Muffo, Ralph O. Mueller, Alan R. Sack); "Strategic Planning for Information Resources Management: Putting the Building Blocks Together" (James I. Penrod, Michael G. Dolence); "Planning for Administrative Computing in a Networked Environment" (Cynthia S. Cross, Marianne J. Elser, Renee W. Frost, Cheryl Munn, Jill Tuer); "Long-Range Strategic Planning in a Decentralized Administrative Information Systems Environment" (William Gleason, John Moldovan); "PULSE: An 'Off-the-Shelf' Decision Support System at Dickinson College" (Ronald Doernbach); "Data Sharing among Campuses: Success and Prospects" (Daniel A. Updegrove, Thomas J. Abdella); "Planning with Technology-LRISP III on Time within Phase and Budget" (Paul Costello, M. Lewis Temares); "Organizing for More Effective End-User Computing" (Denis Pickron, Rick Seaman); "End-User Responsibility within Information Processing Systems" (Betty Laster); "Planning Model for Computing and Telecommunications" (Frank Slaton); "Penn State's Integrated Telecommunications and Teleconferencing Network" (David Phillips); "Library Automation at a Multi-Campus Community College (Deirdre Farris); "Electronic Student Folders" (Robert Adams, David Mannering); and "Academic Computing: From Chaos to Coordination...One Institution's Story" (Trudy Bers, Mary Mittler). (SW)

ED283430

HE 020 404

CAUSE

The Impact of Converging Information Technologies

Proceedings of the 1986 CAUSE National Conference

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it

☐ Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

CAUSE

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

December 9-12, 1986
Hyatt Regency Monterey

The Impact of Converging Information Technologies

Proceedings of the
1986 CAUSE National Conference

December 1986
Hyatt Regency Monterey

Copyright© 1987 CAUSE

737 Twenty-Ninth Street, Boulder, Colorado 80303 (303) 449-4430

Statements of fact and opinion are made on the responsibility of the authors alone and do not imply an opinion on the part of the Board of Directors, officers, staff, or membership of CAUSE. Although CAUSE provides guidelines to authors for preparation of camera-ready papers for the Proceedings, the final appearance of the papers is the sole responsibility of the authors.

Microfiche and paper copies of this document are available from the ERIC Document Reproduction Service, P.O. Box 190, Arlington, Virginia 22210.

Individual papers in this publication are available at the cost of reproduction from the CAUSE Exchange Library.

CAUSE

CAUSE, the Professional Association for Computing and Information Technology in Higher Education, helps colleges and universities strengthen and improve their computing, communications, and information services, both academic and administrative. The association also helps individual members develop as professionals in the field of higher education computing and information technology.

Formerly known as the College and University Systems Exchange, CAUSE was organized as a volunteer association in 1962 and incorporated in 1971 with twenty-five charter member institutions. In the same year the CAUSE National Office opened in Boulder, Colorado, with a professional staff to serve the membership. Today the association serves over 1,800 individuals on 700 campuses representing nearly 500 colleges and universities and 21 sustaining member companies.

CAUSE provides member institutions with many services to increase the effectiveness of their computing environments, including: the Administrative Systems Query (ASQ) Service, which provides information to members from a data base of member institution profiles; the CAUSE Exchange Library, a clearinghouse for documents and systems descriptions made available by members through CAUSE; association publications, including the bi-monthly newsletter, *CAUSE Information*, the bi-monthly professional magazine, *CAUSE/EFFECT*, and a monograph series; workshops and seminars; and the CAUSE National Conference.

We encourage you to use CAUSE to support your own efforts to strengthen your institution's management and educational capabilities through the effective use of computing and information technology.

Table of Contents

The Impact of Converging Information Technologies

Page

Introduction 1

Acknowledgments 2

GENERAL SESSIONS 5

Wednesday Morning General Session 6

Networks and Supercomputers
C. Gordon Bell

Thursday Morning General Session 7

Institutional Excellence: The Role of Converging Information Technologies
W. Ann Reynolds

Conference Luncheons and Awards 8

Current Issues Forum 10

Distributed Access to Central Data: A Policy Issue 11
Eugene W. Carson

Distributed Access to Central Data: The Cons 23
Katherine P. Hall

PROFESSIONAL PRESENTATIONS 29

Current Issues Sessions 31

Artificial Intelligence/Expert Systems 32

Chief Information Officers 33

The Electronic Campus 34

End-User/Distributed Computing 35

Fourth-Generation Software 36

Information Centers 37

Library Automation 38

TRACK I: Policy Issues in Higher Education 39

Overselling Technology: Suppose You Gave a Computer Revolution and Nobody Came? 41
Linda H. Fleit

Selling the President on the Computing Plan: Strategic Funds Programming 53
John L. Green

A Preliminary Report of Institutional Experience with MIS Software 65
Paul J. Plourde

Policy Issues Surrounding Decisions to Use Mainframe or Micros 75
Phyllis A. Sholtys

Alternative Models for the Delivery of Computing and Communications Services 87
E. Michael Staman

Converging Technologies Require Flexible Organizations 103
Carole A. Barone

Student Computing and Policy Issues 115
Gerald W. McLaughlin, John A. Muffo, Ralph O. Mueller, and Alan R. Sack

TRACK II: Planning and Information Technology 129

Strategic Planning for Information Resources Management: Putting the Building Blocks Together 131
James I. Penrod and Michael G. Dolence

Planning for Administrative Computing in a Networked Environment 143
Cynthia S. Cross, Marianne J. Elser, Renee W. Frost, Cheryl W. Munn, and Jill B. Tuer

Long-Range Strategic Planning in a Decentralized Administrative Information Systems Environment 155
William M. Gleason and John C. Moldovan

PULSE: An "Off-the-Shelf" Decision Support System at Dickinson College 167
Ronald E. Doernbach

Data Sharing Among Campuses: Success and Prospects 177
Daniel A. Updegrove and Thomas J. Abdella

Planning with Technology—LRISP III On Time Within Phase and Budget 187
Paul Costello and M. Lewis Temares

TRACK III: People Issues in Information Technology 199

The Staffing Process: Selection, Management, Development, Results 201
Donald L. Hardcastle

Organizing for More Effective End User Computing 213
Denis Pickron and Rick Seaman

Facilitating the Use of Microcomputers on Campus Through the Concentric Circle Model 223
Julie Carnahan and Dennis M. Edwards

End-User Computing at The Pennsylvania State University 233
Kenneth C. Blythe

End-User Responsibility Within Information Processing Systems 241
Betty Marr Laster

Foundations for Success: Creating a Working Partnership with Your EDP Auditor 251
Pamela Clem and Mark Olson

A Model for Mandating Training Policy Changes 261
Anne Woodsworth and James F. Williams II

TRACK IV: Telecommunications/Networking 271

Planning Model for Computing and Telecommunications 273
Frank Slaton

Temple University Communications Project: A Case Study 283
Barbara L. Brownstein and Michael J. Hathaway

Can WANs and LANs Make Good CANs? 295
Stewart H. Robinovitz

A Local Area Network for Administrative Users 305
Lynda Barner and Anthony J. Schaller

Penn State's Integrated Telecommunications and Teleconferencing Network 319
David L. Phillips

Linking College Computing Resources 327
Thomas Warger, David V. Cossey, Mary G. Coates, and Theresa A. Pardo

Network Integration at CSULB 339
Stephen W. Kelley

TRACK V: Special Environments 349

Planning and Implementing a Multi-Institutional Statewide Student Information System 351
Alan W. Hartwig and Leonard M. Brush

Library Automation at a Multi-Campus Community College 365
Deirdre A. Farris

Policy and Organization of Computing, Communications, and Libraries in Diverse University Settings 375
Jack A. Chambers and Jerry W. Sprecher

Developing Technology Assisted Learning (TAL) Centers 387
Marion J. Ball

Planning for Microcomputer Integration: Management Direction 395
Linda Heidel

Implementation of a User-Friendly University Recruitment and Admissions System in a Multi-Campus Environment 405
Patricia Hassett, Clelia Lobosco, Ruth Spitz, Chris Barbariantz, and Michael Fox

TRACK VI: Microcomputer Issues and Applications 419

The Acquisition and Use of Microcomputers on College Campuses 421
Gary Devine, Wayne Donald, James Vanderpool, and Michael Zastrocky

Stretch Your PC Dollars—Buy Clones 439
John F. True

Linking Mainframes with Micros for Request Budget Preparation 447
William L. Tetlow, John Graham, and Betsy Maguire

Migration of Host Computing to Microcomputer Processing at Bentley College 459
Thomas Maggiacomo

Electronic Student Folders 469
Robert D. Adams and David Mannering

Support for Management Microcomputing ... One Step Beyond 479
Kathy Healy Brey and Roy A. Gruver

Micros and Faculty: A Developmental Approach to Instructional Enhancement 491
Morell D. Boone and Robert L. Ferrett

TRACK VII: Managing Academic Computing 499

Academic Computing: Should Students Be Required to Purchase Personal Computers? 501
Joseph C. Miller

Academic Computing: From Chaos to Coordination ... One Institution's Story 511
Trudy H. Bers and Mary L. Mittler

Exploring the Educational Opportunities of an Interactive Video-Based Information System 521
Mary G. Miller

Improving Micro-Based Instruction with a LAN 533
Joseph A. Middleton

The Central Service Node in a Multicampus Network: The CSU Experience 545
James K. Hightower and Penelope Crane

ARIES: Automated Matching of People, Resources, and Opportunities 555
Katy Neff and Tom Martinson

VENDOR PARTICIPATION 561

Participating Vendors 563

American Management Systems, Inc. (AMS) 564

Apple Computer, Inc. 565

Arthur D. Little, Inc. 567

AT&T Conversant Systems 569

Business Information Technology, Inc. (BIT) 571

Business Systems Resources, Inc. (BSR) 572

Cincom Systems, Inc. 573

Compression Labs, Inc. (CLI) 574

Control Data Corporation (CDC) 575

Coopers & Lybrand 576

Cray Research, Inc. 577

Cullinet Software, Inc. 578

Datatel Minicomputer Company 579

Digital Equipment Corporation 581

Ernst & Whinney 582

IBM Corporation 583

Information Associates (IA) 585

Integral Systems, Inc. (ISI) 587

Peat Marwick 588

Prime Computer, Inc. 589

Racal-Vadic 590

Systems & Computer Technology Corporation (SCT) 594

Suite Exhibits 597

BUSINESS AND PLEASURE 599

CAUSE86 600

10

INTRODUCTION

CAUSE86 had as its theme "**The Impact of Converging Information Technologies**," focusing on a technological development which offers a challenge to every professional associated with the use or management of information in higher education. Even a few years ago, campus technologies such as computing, communications, and library resources were considered separate disciplines. But recent developments in communications options and technologies have introduced new possibilities and new questions: how and whether to integrate all these resources (and their management), and how to take full advantage of improved, more accessible information resources. These kinds of questions require institution-wide management decisions.

It is obvious that we must keep abreast of these developing technologies if we are to control our information environment. CAUSE86 was planned to allow thorough, lively discussion of these provocative issues, through track presentations, special interest groups, constituent groups, current issues sessions, and a dynamic Current Issues Forum debate. Although one featured speaker, recently-retired Rear Admiral Grace Murray Hopper (U.S. Navy), was unable to attend due to illness, the two other general-session speakers raised important considerations for conference participants: C. Gordon Bell, Assistant Director of Computer and Information Science and Engineering for the National Science Foundation, talked about "Networks and Supercomputers" on Wednesday morning, and CSU Chancellor W. Ann Reynolds discussed the role of converging information technologies in developing institutional excellence on Thursday morning. Numerous vendor presentations and suite exhibits gave attendees a good opportunity to find out what's going on in the marketplace and to get useful information about new products.

The program was tailored as much as possible to meet requests. Veterans of CAUSE national conferences noticed the increased opportunities for informal sharing of common experiences and interests, as well as the new "project stage" coding for case-study presentations. An all-time high number of registrants—737—were on hand to take advantage of these activities and to renew once-a-year friendships.

We hope these *Proceedings* will be a continuing resource throughout the year, and a reminder of the many opportunities offered by both the conference and CAUSE.

Harry

Harry Grothjahn
CAUSE86 Chair

ACKNOWLEDGMENTS

The success of the CAUSE National Conference is due entirely to the contributions of people and supporting organizations, several of whom deserve special attention.

The CAUSE86 Program Committee (below), under the chairmanship of Harry Grothjahn and vice chairmanship of A. Wayne Donald, spent many hours working with the CAUSE staff to produce an effective, efficiently-run conference. CAUSE gratefully acknowledges their enthusiasm and efforts and the support of their institutions.

1986 CAUSE NATIONAL CONFERENCE PROGRAM COMMITTEE
Front row, left to right: Wayne Donald, Virginia Tech; Mary Sapp, University of Miami; Nina Davis, CAUSE; Harry Grothjahn, University of Georgia. Second row: John Eoff, New Mexico State University; Mark Perkins, CSU/Stanislaus; Joe Catrambone, Loyola University of Chicago; Jim Hill, Dallas County Community College District; Vivianne Murphy, Brown University. Back row: Dana van Hoesen, CAUSE; Phil Charest, Villanova University; Vicki Candella, Cincinnati Technical College; and Floyd Crosby, West Virginia University.

The contributions of time and creative energy of the CAUSE Board of Directors are also gratefully acknowledged and appreciated. Retiring from the 1986 CAUSE Board were Sandra Dennhardt, University of Illinois Central Office; Kathlyn Doty, recently retired from Loyola University of Chicago; John A. Monnier, University of Arizona (who had served in 1986 in an *ex-officio* capacity as the immediate past president of the Board); and William Mack Usher, Oklahoma State University. CAUSE members elected to three-year terms on the Board of Directors beginning in 1987 were Jeffrey W. Noyes of Mercer University; Robert G. Ogilvie, The American University; and David Smallen, Hamilton College.

1986 CAUSE BOARD OF DIRECTORS
Front row, left to right: Jane Ryland, CAUSE Executive Director; Sandra Dennhardt, University of Illinois System; Judith Leslie, CAUSE President, Maricopa Community Colleges; M. Lewis Temares, University of Miami. Second row: Wayne Ostendorf, Iowa State University; John Monnier, CAUSE Past President, University of Arizona; Thomas W. West, California State University System. Top row: Cedric S. Bennett, CAUSE Secretary/Treasurer, Stanford University; Bernard Gleason, Boston College; William Mack Usher, CAUSE Vice President, Oklahoma State University. Not pictured: Kathlyn Doty, Loyola University of Chicago.

The capable assistance at the registration desk of volunteers Margaret Dawson and Ellen Fitzpatrick of Stanford University and June Harvey of San Francisco State University was invaluable, and much appreciated.

CAUSE also thanks all those vendors who set up suite exhibits, gave company presentations, and provided evenings of hospitality. Their contributions add an enormously valuable dimension to the conference experience. Deserving of extra thanks are Racal-Vadic for underwriting the cost of the nametag/meal ticket sheets; Apple Computer for lending an Apple Macintosh and LaserWriter printer to produce nametag sheets on-site during the conference; Information Associates for sponsoring the annual CAUSE Recognition Awards; Systems & Computer Technology Corporation for sponsoring the *CAUSE/EFFECT* Award; Peat Marwick and Information Associates for providing the pre-conference tennis and golf tournaments; Digital Equipment Corporation for underwriting the opening night Registration Reception; and American Management Systems, Apple Computer, Business Information Technology, Control Data Corporation, Coopers & Lybrand, and Integral Systems for their sponsorship of refreshment breaks and breakfasts.

Neither the conference nor the other association activities could continue without the contributions of the five CAUSE Member Committees, which are increasingly creative and active. CAUSE appreciates the time and effort contributed by the volunteers who carry out the duties of these committees. At the Thursday evening banquet, new CAUSE president Cedric S. Bennett thanked the many people who supported CAUSE in 1986 through participation on association committees and introduced the recipients of plaques containing certificates of appreciation for individuals retiring from committees. For their service on the *Election Committee*: James I. Penrod, California State University/Los Angeles; Ernest L. Jones, Appalachian State University; Patricia C. Skarulis, Duke University; Martin B. Solomon, Jr., Ohio State University; and Ronald L. Orcutt, Harvard University. For service on the *Recognition Committee*, Carl L. Koenig, Vincennes University, and Wayne A. Brown, Vanderbilt University. For service on the *Current Issues Committee*: Vivianne Murphy, Brown University, and Elizabeth Glynn, University of Connecticut. For service on the *Editorial Committee*: George Alexander, Clemson University; Albert LeDuc, Jr., Miami-Dade Community College; Constance Peckham, University of Arizona Medical Center Corporation; Norman Wismer, Weber State College; Robert Denning, Pacific Lutheran University; and Christina C. Lowry, University of Miami. The *Program Committee*, all of whose members received recognition certificates, was complimented for its fine work on the conference.

GENERAL SESSIONS

CAUSE86 offered several opportunities for all conferees to convene in general sessions dealing with subjects of common interest. The conference opened with an orientation session offering information about CAUSE as an association as well as advice from CAUSE86 Vice Chair Wayne Donald on how to "cover" all the activities of the conference. This session was followed immediately by the CAUSE Annual Business Meeting, which included a colorful and informative slide presentation called, "CAUSE: Your Professional Association." Two eminent authorities on education and information technology presented general-session addresses to open the Wednesday and Thursday activities. The Board of Directors, Member Committees, and recipients of CAUSE awards were honored at luncheons during the conference. The final general session of CAUSE86 was a Current Issues Forum on policy issues related to distributed access to central data.

WEDNESDAY MORNING GENERAL SESSION

Networks and Supercomputers

C. Gordon Bell
Assistant Director
Computer and Information Science
and Engineering
National Science Foundation

The speaker for CAUSE86's opening general session was C. Gordon Bell, Assistant Director for Computer and Information Science and Engineering for the National Science Foundation, and a former vice president for engineering at Digital Equipment Corporation and professor of computer science at Carnegie Mellon University. His address, based on his extensive experience at the forefront of technological research, dealt with the establishment of centers of advanced scientific computation for the research community, using vector processors, and the development of a network linking the entire research community, using the networks associated with the supercomputer centers as the backbone—an interesting approach to the conference focus on converging information technologies.

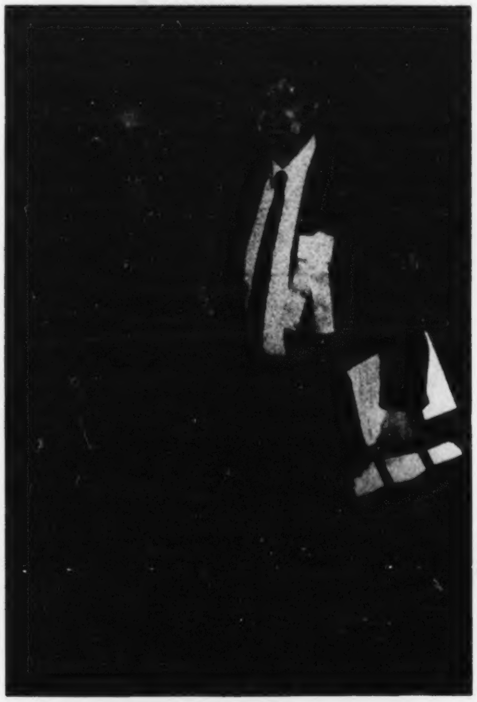
HARRY ROTHJAHN
C. GORDON BELL
WAYNE DONALD

THURSDAY MORNING GENERAL SESSION

Institutional Excellence: The Role of Converging Information Technologies

W. Ann Reynolds, Chancellor of the California State University, is currently pursuing initiatives involving enhanced opportunities for women and under-represented minorities, the preparedness of students entering the CSU, and new programs in computing and high technology. In her Thursday morning address to CAUSE86 conferees she discussed the necessity for every institution to develop a focused vision for the future which relates the mission and programs of the institution to the needs of the public it serves. Dr. Reynolds identified some of the strategic issues, obstacles, and opportunities which will affect institutional excellence by the turn of the century and outlined how the converging of information technologies can play an important role in attaining new levels of institutional excellence.

W. Ann Reynolds
Chancellor
The California State University



Ann Reynolds and
CAUSE Board member Tom West

CONFERENCE LUNCHEONS

At the Wednesday CAUSE86 luncheon conferees were entertained and refreshed by doing SITTERCISES, exercises performed in a sitting position (more or less unobtrusively), under the direction of Terrie Heinrich Rizzo, president of Personally Fit and an international fitness consultant, in a brief introduction to her copyrighted program. New Board members Jeff Noyes, Bob Ogilvie, and David Smallen were also introduced, and retiring Board members received thanks for all their contributions to the association.

Thursday's luncheon was an awards luncheon featuring the announcement of the 1987 CAUSE officers and presentation of the 1986 CAUSE Recognition Awards and the *CAUSE/EFFECT* Contributor of the Year Award (see facing page).

Outgoing President Judith Leslie presents the gavel to newly-elected President Ced Bennett.

1987 CAUSE President Ced Bennett presents a plaque commemorating her presidency to Judith Leslie.

Terrie Rizzo, president of Personally Fit, leads conference participants in SITTERCISES, to prepare them for the afternoon's sessions.

AWARDS

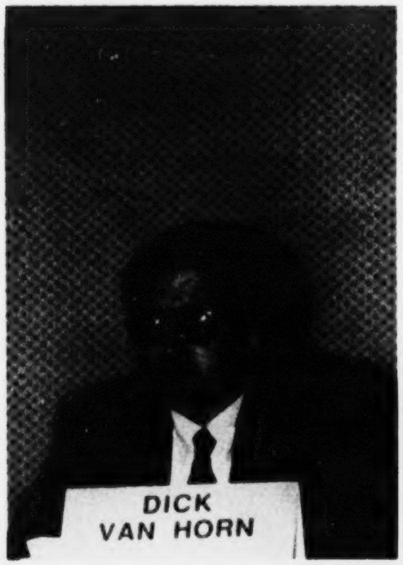
Charles H. Naginey (center, left photo) and Douglas E. Van Houweling (center, right photo), display the plaques awarded to them as recipients of the 1986 CAUSE Recognition Awards for excellence and leadership in the field of computing and information technology in higher education. Conducting the ceremonies were Judith Leslie, CAUSE President, and John Robinson, President of Information Associates, who sponsored the awards. Mr. Naginey is recently retired from the position of Coordinator of Administrative Computing and Planning at The Pennsylvania State University, and Dr. Van Houweling is the Vice Provost for Information Technology at the University of Michigan.

Al LeDuc (center), Director of Computer Services Planning and Analysis at Miami-Dade Community College, receives a plaque from CAUSE President Judith Leslie commemorating his winning the 1986 CAUSE/EFFECT *Contributor of the Year Award. Systems & Computer Technology Corporation, sponsor of the award, was represented by General Manager Stephen B. Adler (right). The award was given for Mr. LeDuc's article, "Why Planning Doesn't (Always) Fulfill Expectations," which appeared in the September 1986 issue of* CAUSE/EFFECT.

CURRENT ISSUES FORUM

Distributed Access to Central Data: A Policy Issue

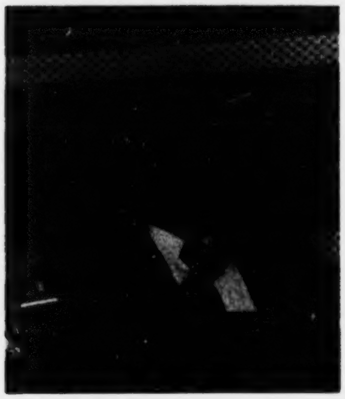
Friday General Session



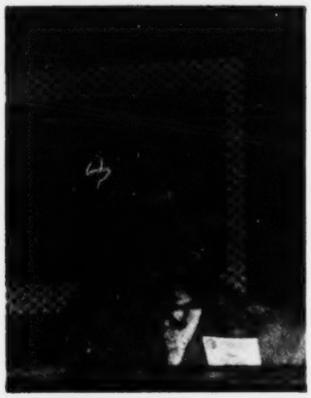
Moderator Richard Van Horn
University of Houston/University Park

With the merging of technologies has come the capability of distributed access to central data bases, and an accompanying demand among academic users to take advantage of the capability. But just because it *can* be done, *should* it be done? This was the subject of the closing session of CAUSE86, organized by Current Issues Forum Chair **Vivianne Murphy**.

In a discussion moderated by **Richard Van Horn**, President of the University of Houston/University Park, **Eugene W. Carson**, Associate Provost at Virginia Tech stated that administrators, faculty, and staff should have electronic access to records needed to perform their jobs, that students should have access to their own records, and that distributed access need not encourage misinterpretation nor inaccuracy of data. Taking an opposing position, **Katherine P. Hall**, Brown University Registrar, argued that such systems may result in rapidly escalating expectations about the on-line availability of information followed by a "hype vs. reality" disillusionment: development should proceed in stages, with attention to legal, technical, and practical limitations.



Gene Carson
Virginia Tech



Kay Hall
Brown University

Vivianne Murphy
Brown University

DISTRIBUTED ACCESS TO ADMINISTRATIVE SYSTEMS

December, 1986

E. W. Carson

Virginia Tech
Blacksburg, VA 24061

Introduction

With the development of computers we have gained marvelous devices for the storage, rapid retrieval, and analysis of very large amounts of data. Computers increased by a factor of a million the speed with which we can retrieve and process data. Electronic communications also provided a leverage factor of a million fold in the speed of communications. More recently we have seen the marriage of computers and electronic communications which has given a synergism never before known. We have multiplied a leverage factor of a million by another leverage factor of a million!

There have been many synergistic combinations of technologies but never has there been one of such magnitude nor one with so much potential to affect our daily lives and the way we work. The above concept of the multiplication factors of these two major areas of technology was presented at the 1973 CAUSE National Conference by Dr. W. J. McKeefery.

The joining of the computer and modern communication technologies provides both opportunities and responsibilities. Higher education has an opportunity to increase productivity, to control costs, to increase services, and to provide administrators with important data and powerful decision making tools. We also have a responsibility to provide leadership in the development of effective methods of using and controlling this dramatic technological leverage.

A few institutions of higher education have installed equipment, developed or purchased software, developed security systems, and implemented policies to take advantage of the computer-communication revolution. These who have done so and those who will use these tools must not forget that the same technologies which deliver administrative support also can be significant instruments in teaching. The same hardware and software which provide data security and provide high speed and long distance communications can also be used as the basis for an educational delivery system.

Modern Records Systems

Records systems, including student records, need not require paper records. Modern record systems are electronic and the data should be available on-line. They provide real-time data when such current data is needed. Administrators, faculty, and staff should have electronic access to all records needed to perform their assigned responsibilities.

Various aspects of the system features described here exist in part in many institutions. Not all of the features presented are known to be available in any one university. However, Virginia Tech has in place the policies and the support structure for the full development of these functions. The University has supported the concepts behind distributed access to administrative systems. At Virginia Tech 29% of all employes are authorized to use the system. Approximately 42% are authorized when only administrators, faculty, and clerical positions (non-trade) are considered. Expectations are that the number authorized will exceed 3500 in the next several years. Currently we have over 400 separate transactions for inquiries and updates into the administrative data bases.

Numerous examples given here are drawn from the systems currently in use at Virginia Tech. Many of these examples are drawn from the currently used functions provided by the Student Systems at the University. However, we have only recently begun the implementation of the distributed authorization system. While at Virginia Tech both administrative and academic computing is done in the same machine, we do not now have in place a system which truly presents a single system. Current goals do include such a single system image and protyping of the system is under development.[1] The principles outlined here should be applicable to any university records system.

An on-line records system implies fully distributed access to records for both inquiry and updates. In the inquiry mode the custodian of the data base has responsibility to provide data to those who need it. The same steward may also provide tools for data selection, for update functions, and for certain report generating functions.

Inquiries

Some data are considered public information. These data should be made available to all administrators, faculty, staff, and students. Such data might include historical statistics on course enrollments, currently available seats for a given course, time-table and catalog information, admissions statistics, average faculty salaries, enrollment statistics by majors and class levels, and degrees awarded by colleges and majors.

Most data are not for public distribution but should be easily accessed as needed by those authorized. All employees should be able to inspect their own personnel data. Department heads should be able to access current budget data for their departments. Principal investigators for research projects should have access to their project budgets. Deans, department heads, and faculty must have access to the academic records of their own students.

Students should have inquiry access to their own records. Examples of individual student information which should be available for her inquiry include:

- Current registration,
- Term by term course enrollments and grades,
- Transfer credits,
- Demographic data,
- Advisor comments from advising sessions,
- Academic suspensions, and
- Progress toward a degree.

Updates

In the update mode the responsibility for seeing that updates are made is the person providing the initial data or making decisions which result in the need for updates. Another view is that those who do not supply the information or add value to the process should not sign forms or update data. This is the well know principle of source point data capture: If you don't add value to it, don't touch it. Such source point data capture and updates could include every item of data associated with individuals, accounts, purchases, inventories, or facilities. Faculty could update selected demographic data about themselves. Administrators could allocate positions and funds. Departments could appoint personnel. Purchasing agents could monitor inventories. Departments could reassign or transfer equipment ownership and transfer appropriate funds. And all of these activities can be performed by direct updates into the university data bases.

Students should also have update responsibilities for selected data elements in their own records, for example:

- Course registrations,
- Request for graduation analysis,
- Address changes, and
- The control of the release of their addresses to other than advisors and university officials.

---

[1] See Robert C. Heterick, Jr. September 1986 CAUSE/EFFECT for a discussion of the single system image concept.

Faculty advisors should be able to record advising comments into the university records of their advisees. Deans or department heads could have access to approve course substitutions for graduation requirements for individual students.

All updates can be controlled to conform to broad university policies. An example follows. Virginia Tech has an on-line registration program which checks for all standard university registration policies with respect to maximum course loads, pass/fail courses, grade point requirements, and deadlines. College deans have access to selected features with override capabilities for those policies to which they may grant exceptions. Terminal operators provide no added value to the registration process. They approve no exceptions, provide no academic advising, and do not enforce any deadlines not already monitored by the registration program. Thus, there are few arguments against students processing their course registration changes. Plans are under way for releasing both inquiry and update functions directly to students for their own records.

Failure to distribute the update functions is a major deficiency which prevents full utilization of the unique advantages of electronic records systems. Specifically, distributed update functions can reduce the need for costly reentry of data and associated entry errors, reduce the need for forms, reduce the time for processing, and provide an improved basis for accountability.

With a well designed and supported records system no forms should ever be forwarded to another office for simple data entry. No form, paper or electronic, should ever require processing by anyone who does not add value to the information or who does not provide essential approvals.

Advantages

The advantages of distributed access include the following:

- Information is available quickly,
- The same data is available to all who need it,
- The data is more likely to be current,
- Responsibilities for accuracy and timeliness are easily assigned,
- Needs for printed documents are reduced,
- Peak load processing is improved,
- Problems of wanted and unwanted destruction of confidential papers and of unauthorized access to the papers are reduced,
- Storage of redundant information is reduced,
- Storage space needed is reduced, and
- The clerical labor needed to maintain files is reduced.

Several of these advantages deserve further comment. The paper saving is real. At Virginia Tech we were able to eliminate the production, distribution, and filing of a half-million paper forms and documents a year. Since distributed access includes update functions, the application of source point data capture spreads the data entry work among many offices. These many offices can better absorb peak load processing with hiring additional staff than can a single office.

User Directed Analyses and Reporting

A complete distributed access system for administrative information should include user directed data selection and output specifications. User directed processing removes the strict limitations imposed by simple preformatted display and update screens and as presented by preselected and formatted tables, lists, or graphic reports. User directed processing is the basis for the fourth generation level (4-GL) software. User directed processing can be provided by commercially available 4-GL packages, by locally developed software, or by creative uses of older generation software packages. Salient features of a user directed system include the provisions for the user to:

- Select the population desired.
- Determine the data elements needed.
- Specify the output specifications.
- Direct the processing of the data with or without programming skills.

As is essential with simple inquiries and as with update functions, user directed processing must be under a well designed and administered security system. Security issues are discussed in somewhat more detail elsewhere in this paper. The standard conditions of authorized access and data value security apply to user directed processing. Thus, under an appropriate security system the user should have access to request selected populations for user directed processing.

The user should be able to select the data elements needed and receive only those data items specified. A well designed system should permit complete user control of processing after the security controlled selections are made. However, the system should also provide for basic reports and simple output control without the need for any programming on the part of the user.

User directed output can take many shapes. The office providing the access may provide a set of flexible reporting formats. These reports might be in tables, charts, graphs, lists, or predefined files for subsequent processing. An example of additional user directed processing is the use of the resulting output as data files to produce "personalized" letters, memos, and forms. In all of these above cases the users should not be required to be skilled in programming.

A flexible user directed access system will also provide for user controlled output which can be directed to the user's mainframe files or to the user's personal workstation.

Data Definitions

User directed processing poses a potential problem of data misinterpretation. Distributed access, especially access which permits user directed processing, must be accompanied with carefully prepared definitions of the data elements. The data element can be clearly defined as an integral part of the data element selection process. Effected systems must be designed for the initiated. No user should ever have to know the subtle nuances associated with data codes and the unique meanings of obscure code combinations. While these codes and combination meanings may exist, their existence should remain unknown to the user.

Inquiry into a data element dictionary can provide clear data definitions and point to the responsible offices. Access to the data element dictionary may be by data value authorization. That is, individuals need not know of the existence of data they are not authorized to use.

Some have made distinctions between distributed data bases and distributed processing.[2] The distinction is that the distributed data bases may exist in numerous machines, whereas, distributed processing implies that the data bases are in a single physical location but are processed from numerous locations. I make no such distinctions here. For these discussions, I am addressing the processing of data from many and widely distributed locations. However, the data bases may be in single or in many locations, In fact, under a single system image, the user may be unaware of the location or format of the stored data.

---

[2] George Schussel, President of Digital Consulting Associates, Inc. as cited by Nell Margolis in Digital Review, November, 24, 1986.

Real-time vs. Static Data

Most up-date functions and simple inquiries should operate upon the university's data base in real-time. Some applications, including many reports and information for management decisions do not need real-time data. For these applications, careful consideration should be given to balancing high security access, the usefulness of real-time data, response times, data consistencies, and data duplications. Most management information need not be real-time. In fact, census data is often more useful for planning and for management decisions. One is simply more likely to hit a sitting target. Census data is static and reflects the same factors operating on each cycle of data. Census data better represents the still target. Thus, provisions should be made to either date stamp critical data elements or to capture selected data at specified times.

Providing the Tools

The responsibility for providing the tools for data analysis and for report generation may be placed in one or more offices, such as:

- An Information Center,
- The office responsible for the security and integrity of the data and for the primary processing of the data, or
- The individual end users who may direct and control the form of the analysis and reporting.

In fact, all of the above options may be correct for a given set of conditions. The originating office which stores and processes the data as an administrative function may also provide simple inquiry functions and a few simple reporting functions. An Information Center could conduct complicated analyses, projections, and comparisons with outside sources. Users with sufficient skills and special needs may desire to have the data in a somewhat "raw form" for very specific processing.

The roll of Information Centers is likely to change as personal workstations are provided with more storage, faster processing, and more sophisticated software. Individuals directly responsible for the various parts of the university data base are more likely to understand the needs of the offices they are charged to serve than are the personnel of a single office. The natural desire to direct processing and output, the fact that individual user needs will vary greatly, the availability of software which does not require detailed programming, as well as, the growing number of highly computer literate personnel will all encourage the shift of data selection and information analysis to the end users. Information Centers may continue to deal with special data collection, sophisticated analyses, and the integration of data from sources from which the users should not be routinely authorized to access.

Security

Distributed access can be provided in a secure environment. Inquiry and update functions can be secured independently. Access to records must be limited to a "need-to-know" basis. The records system must include data values to permit such security checking. This is known as data value security and requires the matching or checking of the values of data elements in the target record and a record associated with the user. The data values associated with the user may be internal to the authorization system but may also be located within a separate data base such as the personnel data base. In the case of student records, the authorization system would access the personnel record of the user to confirm that the person seeking access is employed in the department of the major for the target student record. For college level administrators and staff the checking routine would verify that the student was in the college of the user seeking access.

Provisions must be made to secure data bases to the data element level. In addition, security systems must permit access to data elements based upon the value of the elements and upon data values associated with the person seeking access. These last data elements might include the department in which the individual is employed, the person's job classification, or specifically assigned authorization classifications.

Widely distributed access can present new management problems associated with data security. In a large university, the volume of authorizations and updates to the authorization system can become a significant burden on the Data Administration staff. Virginia Tech now has over 1500 employees authorized to use the administrative records systems. A solution to the problems associated with large numbers of authorizations has been previously described.[3] The overall security system solution has many key features:

- Individuals and not offices are authorized,
- Individuals are authorized with respect to their job responsibilities,
- Changes in employment status (resignations, retirements, dismissals, a change in position, or a change to a new department) require new authorizations,
- Transactions may be grouped by functions which are job related,
- Transactions may be distributed by a functional group,
- Authorizations within a group of transactions can be restricted by data values,
- The data values which restrict access may be in the records requested and in the personnel records of the person seeking access,
- Authorization authority can be distributed or restricted,
- Audit trails exist for all authorizations (dates and who authorized),
- Authorization verifications are required for each new record sought,
- Authorization verifications are required on each update screen, and
- Periodic changes in authorization passwords are required.

This approach includes predefined and programmed restrictions based upon data values associated with the record and with the person seeking access. In addition, this distributed authorization disperses the work load while also making each level of management a full participant in the security system. All users who access the system must assume responsibility for protection of their authorizations. This required and active participation on the part of many administrators and all users should increase the awareness of the need for data security and for protecting the rights of individuals. The constant reminders imposed by the security system underscore the need for confidentiality of the data updated or viewed.

Figure 1 illustrates the directional flow of authorizations from selected administrative support offices. Keep in mind that the arrows illustrate the flow of authorizations and not the flow of data. Authorized individuals may provide the authorizing office with data via update functions; these relationships are not contained in the figure. In this example, the offices of Personnel, Purchasing, and Budget must provide at least inquiry access to all other units. On the other hand, the Registrar needs to provide access to individual student records only to the staff of the Personnel Office; these persons may need to verify if someone being paid on student wages is, in fact, a qualified student. Neither Purchasing nor the Budget office staff has any need to access individual student records.

Figure 2 presents the authorization flow from the Registrar to several offices served by the

---

[3] Lore Balkan-Vickers, November 1986 CAUSE/EFFECT.

Registrar. The flow between Admissions and Financial Aid is also shown. Note that in this case Admissions must provide access to the staff of Financial Aid for them to properly award aid. No other office, except Student Accounts, needs (or has!) access to student financial records. Student Accounts does have access for billing purposes when scholarship and other aid might be involved. The Registrar must permit Financial Aid to verify enrollments and academic progress. Admissions and the Registrar must each have access to the other's data for registrations and readmissions. The bottom half of Figure 2 is significant in that it illustrates the concept of distributed authorizations. As shown, the Registrar can distribute authorizations to a college dean who distributes to departmental administrators and they to the faculty. The decreasing width of the authorization lines indicates functions authorized for one office are passed to the next level. In fact, the authorization system permits the Registrar to distribute a function to a college dean and, at the same time, restrict the dean from any further distribution of that function.

Audits

Certain data items require the storage of the time or date on which the last change was made. Some require date stamps for each change. These dates are usually associated directly with an item and are used in interpreting the data.

Other date stamps may be needed as part of audit trails for selected data elements. The dates should also be associated with the identity of the person making the update. In some cases, audit trails are needed on inquiries. Audit data can be useful in analyses of uses and can be essential in investigating possible security violations.

Access control can be achieved in a variety of ways. Authorization codes, passwords, demographic queries, personal physical characteristics, and physical devices all may be used alone or in combinations. Individual authorizations for access and data valued controls are important features of the authorization system at Virginia Tech. Authorized access under an appropriate security system is assumed for all of the discussions here. The salient points to remember is that access must and can be controlled, that access can be data valued with respect to the records and with respect to the person seeking access. Finally, access should be available to all who need inquiry or update capabilities in the performance of their job.

Data Administration can provide critical support to the distributed access systems. Such an office is the logical unit to monitor periodic backups and check on off-site storage of backup copies. Data Administration is also the office to provide post audit data to the data base stewards. Detection of attempts to breach the security system is also a reasonable function of an Office of Data Administration.

Integrated Systems: A Single System

The implementation of a distributed information system can be made more cost effective and more user friendly if the users do not have to be concerned with learning new protocols, new devices, and cryptic codes and computer instructions. Simple terminals should provide easy access for inquiries and selected updates. Intelligent personal workstations (micro computers) should provide the additional functions of data transfers and local data analyses.

Distributed access implies authorized access to clearly defined single sources for the same information by all who need it. Distributed access does not prevent the physical distribution of the data bases but does imply shared data bases with little or no duplication of specific data items. The physical location and the format of the data may be transparent to the user.

An individual should not be required to have multiple devices on hand (or to travel to specific locations) to perform a variety of tasks. For example: a faculty member should be able to:

- Determine who is enrolled his class,
- Search the library for materials for a class,
- Place selected library books on recall and reserve,
- Check on the academic status of her advisees,
- Look at the current budget status of her research grant,
- Enter into the university data base an advising comment about a student,
- See if seats are available in his class,
- Send a document to a colleague in another state,
- Respond to a note from her department head,
- Place an order for computer diskettes,
- Grade a project sent electronically by a student,
- Modify a simulation in preparation for a class,
- Request a summary of last year's admissions statistics,
- Obtain a formatted list of names and addresses of her Honors advisees,
- Update the campus directory with his new home telephone number,
- Transfer a current class roll for grade processing,
- Prepare a research proposal,
- Submit a paper to a professional journal, and
- Analyze a set of data received from his graduate student.

The faculty should be able to perform all of the above in a single session from a single intelligent workstation. In fact, she should be able do this on a quiet snowbound weekend from the comfort of her home. Note that no division of the above tasks has been made into those which are simple electronic mail, data base inquiries, or data analyses. A single system will make such distinctions unnecessary.

The faculty member should be able to perform these same tasks on a variety of machines and using any of many communication methods. Access and output should be device independent.

Implementation

Certain policies, facilities, and centralized support are essential for implementing a distributed records system. The policies issues are few and simple. Only systems which require source point data capture should be selected or developed. No processing should be required by anyone who does not add value to the data or who does not make **essential** approvals. The university must establish that electronic records are the official records and that electronic "signatures" are official signatures for access and approvals. Stewards of the data bases have responsibilities to share as well as to protect data. The facilities support is more difficult because more than a stated commitment and mind set are needed. Both centralized and departmental resource allocations may be needed and end user decisions oh expenditures may be involved.

Summary

Widely distributed access need not encourage misinterpretation of information nor make data less secure.

Implementation of an electronic records system can be easy but requires the establishment of policies and assumes strong central administrative support. Institutional commitments to shared data bases, source point data capture, value added processing, destination document production, a centralized (but distributed) data security system are essential and must guide the selection and development of software. Policies and job descriptions must clearly establish that administrative data bases are university resources and not the private property of individual offices.

All persons who have a need to access data must be provided that opportunity. Individuals assigned responsibilities for a data base must also see that the appropriate data are made available as needed. Data must be secured against unauthorized inquiry or unauthorized updates. The central administration must provide the communications system. Departmental level units and the central administration may share in the allocation of resources for equipment and selected software. Top administrative support for a distributed records system is essential to its success.

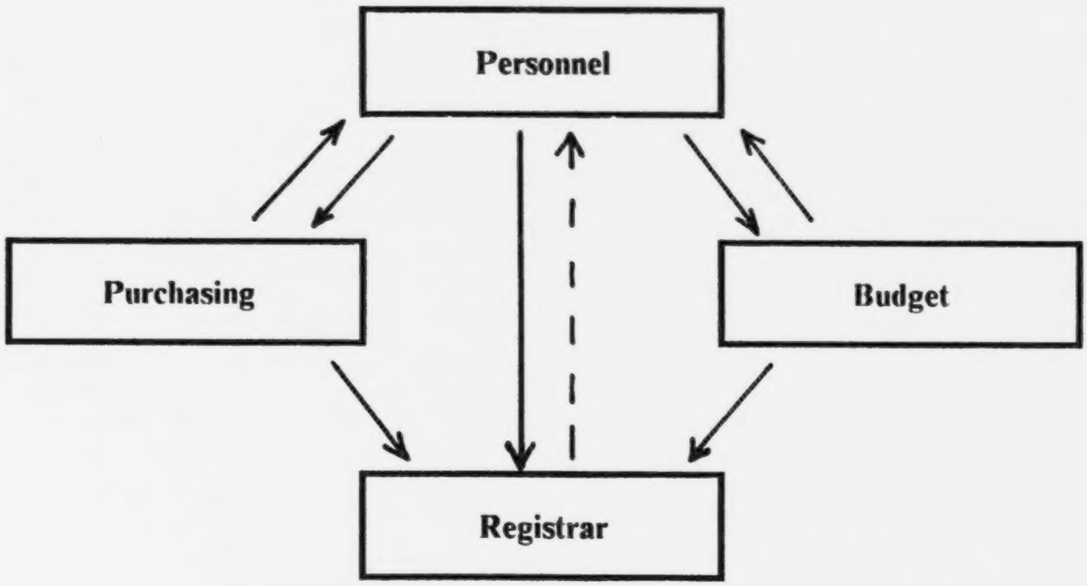

Personnel
Purchasing
Budget
Registrar

Figure 1. Flow of authorizations for distributed access to data from selected administrativ offices.

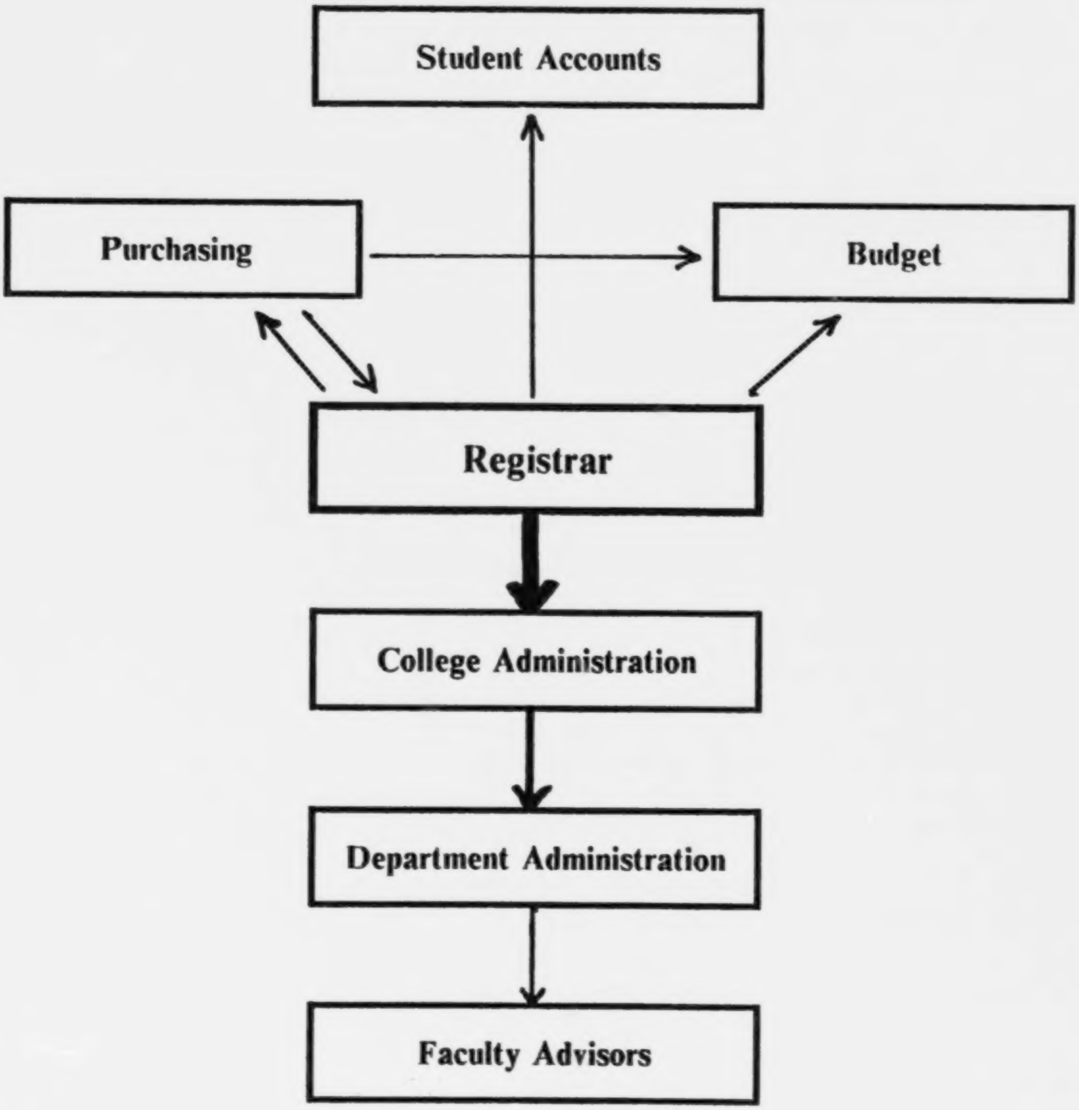

Student Accounts
Purchasing
Budget
Registrar
College Administration
Department Administration
Faculty Advisors

Figure 2. Flow of authorizations for distributed access to to student related data.

"Distributed Access to Central Data: The Cons"

Dr. Katherine P. Hall
Registrar and Dean for Curricular Research
Brown University

Being asked to speak about the "cons" associated with distributed access to university information has made me feel like the stereotypic bureaucrat, claiming ownership rights to his or her database and being unwilling to cooperate with others for the common good of the institution. Actually, within my school, I'm a proponent of shared access to University databases, although the difficulties we have encountered in moving that direction often make me feel more like an apologist than an advocate.

I'll be speaking largely out of my experience at Brown University, and I hope our experience won't seem so exceptional as to be unapplicable to other situations. I do have a sense from talking to administrators within my home state and within the Ivies, that we are not alone.

At Brown we began planning in 1979 for an integrated student system containing records from Admissions, the Undergraduate College, the Graduate School, the Medical Program, Student Life, Residential Life, Registrar, Bursar, Loans, and Financial Aid. When we began the effort, I was an associate dean of the undergraduate college and part of a planning team which developed the outline for the system. The first major portion of the system became operational in November 1983, and as is usually the case, the first year of operation was turbulent. One year later, I became Registrar and Dean for Curricular Research. I was offered this job and accepted it in part because I had made a commitment to make this new system work for us.

When we started, the possibilities sounded wonderful. There would be no need to prepare and mail multiple copies of every transaction to a half dozen different offices, and therefore, less paper to file. The clearly defined information maintenance responsibility would promote accurate and timely record keeping and eliminate duplicate records. All these efficiencies would enable staff reductions in several offices, and we actually planned to offset part of the costs of the system through these reductions. Best of all, with everyone tapping into same database, all university officers would have quick access to the same data. We would no longer have the problem of one office presenting figures which were substantially different from those presented by another.

Seven years after our beginning have we arrived at the Promised Land? Note quite. There has been substantial development of the system in the past three years, and we have made significant progress toward some of these ends. But we have discovered many obstacles on the path toward data sharing. Some goals still are distant, while others, most notably staff reductions, now seem absurd. The impact on staff that we have observed is that many jobs have become more sophisticated, requiring advanced levels and higher salaries than before.

Actually, our SIS now works pretty well, but because expectations surrounding the system exceeded the reality, we have problems of frustration, irritation, disillusionment, and a general sense that it really isn't all that good. I often have to remind colleagues that it also isn't all that bad, despite the fact that some of our hopes are still years away. People forget that we are better off than we were seven years ago and grumble that we're so far from where we should be.

How can you keep this from happening at your institution? I would argue that two things are essential, and both have to do with preventing expectations from getting so far ahead of reality that disillusionment and negativism set in. First, keep your practical and technicial limitations in mind when you "sell" your new system internally. Second, in developing the system, you must also develop an institutional philosophy of information sharing, so that users and prospective users will understand just what will be available to them and why.

Keeping your practical and technicial limitations in mind means thinking realistically about the problems of implementation, training, usage, acceptance, and so on. It also means knowing the overall level of organizational and financial support available to the effort, although it can be difficult for an MIS director, a computer center director, or even a senior dean, to accurately gauge how much support will be available, particularly when unexpected difficulties are encountered. I wish we had given greater attention to the following questions:

(1) Are you limited by availability of hardware, software, or terminals? Do you really have the computing power to support a large, online system?

a) One of our first obstacles was limited access to terminals. Fifteen offices have update responsibility for online maintenance of our student system. When we first began to operate it, we were severely hampered by lack of equipment in many offices. The Registrar's Office had only six terminals with which to maintain several hundred items of information on each of 7,500 students. Several updating offices had no terminals at all, and a few still lack them.

The problem here is that offices were expected to purchase the equipment needed to maintain or query the system out of existing equipment funds. Many offices preferred to buy furniture, typewriters, or micro computers which were not linked as terminals to the mainframe. To my knowledge, no carrots or sticks have been used by the administration to induce offices which might be deemed "reluctant partners" to participate. One result is that the Registrar's Office has found it necessary to take over update responsibility for some offices which have less need for and therefore less interest in supporting the system.

b) We also suffer from an overworked and unreliable mainframe, with the result that the system goes down during working hours several times a week, creating great frustration on the part of everyone whose work intersects with the system. Even when it's operating, we often have unacceptably slow response time. The mainframe problem is so bad that I find myself discouraging new users because, at the present time, more users simply means slower response. If the clerks responsible for information maintenance can't perform their tasks, there won't be useful information for managers to query.

c) Third, we have encountered software limitations. We do not at the present time have access limited by data values. The software is available -- the University is already using it for smaller systems, but we have not yet been able to bring the large student system under it. As a result, some applications which would be of considerable value to academic departments are not available. Users in those departments are irritated because they know the information exists, and a few suspect that bureaucrats like me are just being recalcitrant in not allowing them access to it.

d) Another problem is that we still lack an online report generator. Again, the software exists, but we haven't gotten to it yet. Three years ago, when we first began to use our system, daytime use was limited to updates and queries of records on individual students. It was not possible to compile any summary reports during the day. We have improved on this situation with a FOCUS extract containing directory information and other basic biographical data. It is available 22 hours per day and is a great help to offices like Security and Health Services, which may need to know a student's status or home address at hours when the "real" system cannot be accessed. The FOCUS extract is a boon also because it allows some simple online reporting, such as the number or names of majors in a particular department, or the number of currently active graduate students, but it still falls short of expectations.

Complex reports and ad hoc requests must be written in Mark IV and run at night, but very few offices have developed any degree of Mark IV programming capability. This means that some offices with considerable responsibility for maintaining the information system are unable to get much back from it in the way of special reports which undermines their commitment to the system. Most users turn to the Registrar's Office or Management Information Services for even such basic requests as mailing labels and lists of majors. A complicated special request, for example a listing of juniors who have completed fewer than three sciences courses, may sit in my office for months before my staff can find the time to write the program. This has proven to be a major annoyance to administrators at all levels and to faculty committees.

(2) Another set of difficulties has to do with training and acceptance on your campus. How are you prepared to deal with the natural inertia which most individuals exhibit when they are expected to alter work habits that have been firmly established over a period of years? What is the existing level of computer literacy on your campus? Are people knowledgeable about the processes followed in various offices? What training must be provided before users can make sense of the data available?

a) Training of end users has been and remains a major problem for us. We knew from the beginning that we lacked sufficient resources for staff training, and that remains a problem even after three years. However, I don't think we appreciated the fact that a distributed access system requires continuous, ongoing training. We have ten offices which have fewer than twenty data fields to maintain. In many of these offices, maintenance is performed by a single individual. When that person quits, is ill, or on vacation, information isn't maintained. In a couple of offices, updates are performed so infrequently on such a small number of items that staff forget how to use the system and need refreshing every semester. In a small office, the loss of one employee may mean that the office no longer has any interest in or ability to maintain its items. In some cases, we've given up on smaller offices and the Registrar's Office has assumed responsibility for maintaining data that it does not generate. This is not an advisable principle, but we've resorted to it in order to keep the information accurate.

b) Closely related to the problem of getting offices to master new skills and knowledge is the challenge of getting people to accept the electronic record as "real," i.e., as the official record of the University. People often have their trust firmly associated with their paper files and are reluctant to bother with a new method. For some people, the promise of having more information available through a new system is a strong inducement to learn new skills and patterns of work. Many others will fail to see any need for a complicated new way of doing things and will require encouragement or prodding to accept the innovation. As a social scientist, I am accustomed to expect resistance to change, but I have been surprised at the strength of the resistance to our information system. Establishing the norm that the electronic record is the official University record may help motivate some of these resistant individuals.

For example, each fall I provide the Dean of the College with a report on the number of students in various categories which she shares with the entire faculty. For three years in a row, the director of an office which maintains some information vital to this report has complained that the figures were incorrect. The first year, I was unaware that the information wasn't accurate. For the next two years, I sent him a note in advance of preparing the report asking that the information be updated before the report was run. Each time, the updating wasn't done, the report was prepared, he complained that the numbers were wrong, and I replied that the Student Information System is the official record from which reports for the Dean, the federal government, and others will be generated. Now, after three years, this office is beginning to maintain the information in the system. I noted earlier that we seem to lack incentives for prompting reluctant partners to participate. It does seem odd to me that it should fall to the Registrar to pressure other offices to maintain their records, but in the absence of any other pressure point, this is what has happened.

c) I have been surprised at how long it is taking for some very fundamental levels of awareness to develop throughout the University community. For example, I am often questioned as to why an enrollment count produced by my office doesn't match one prepared a day or two before. I still have to explain several times a month that, since the system changes minute by minute through "live" updates, a report run on Tuesday won't produce exactly the same result as the same report run the next day. Many faculty and administrators still seemed geared to the results produced by massive batch updates at certain points in the semester. To them, things "seemed more stable" in the old days. Of course, they were stable only because they were out of date.

On a more sophisticated level, we are finding that it takes a very long time for people in a range of offices to become familiar with the data fields and how they might be useful to them in their work. Even when documentation is available, many users do not consult it frequently and become confused about the content of fields with similar names. For example, my office maintains an expected date of completion for every degree candidate and also a flag to identify probable graduates for the next Commencement. Users outside the Registrar's Office perceive these fields as interchangeable, though they in fact contain slightly different information. Unfortunately, other offices have used the fields incorrectly and gotten incomplete or inaccurate reports. Problems of this nature are very widespread and are not abating. Again, due to staff turnover and the gradual growth in use of the system by a variety of offices, it appears that continual training and refreshing on the content of the database will be necessary.

In developing a distributed access system, you must also begin to develop an institutional philosophy of information sharing. At Brown, we started, as most institutions do, by simply considering which administrators, or which administrative offices, should have authority to view each field in the database. That is an essential first step, but if you stop there, you will quickly run into difficulty, because once your system is "online," requests for information proliferate rapidly. Almost immediately, we began to receive requests from faculty and departmental offices which had not been included in the initial definitions of authority to view.

How should you go about developing an institutional philosophy? I will suggest things which I hope we will begin to do early next year. One is to assess what the general atmosphere is within your institution regarding "openness" of information. Obviously, you should know your legal requirements, but even what is legally accessible is subject to wide variations in interpretation. Does your user community understand that the Family Educational Rights and Privacy Act requires that student information be released internally only on a need-to-know basis? If it does, do you have shared understanding about what constitutes a need-to-know?

For example, if faculty want online viewing of transcript information in order to look at a student's entire record before writing a letter of recommendation, is that a legitimate need-to-know? At Brown, we say it isn't.

Does your development office have a need-to-know the educational background and occupational status of current students in order to identify development prospects and tailor fundraising approaches to particular individuals? Many campuses would say yes, but at least one University Counsel has determined that such access is not warranted.

What if a faculty committee wants a report on faculty salaries by department? If you are a state university where salaries are a matter of public record, this may not sound like an unreasonable request. But at my school, salaries are highly confidential. Such a request would be considered outrageous, and provision of salary data, even in summary form, would constitute a major security breach.

How will you respond when the Psychology Department wants a downloaded file of SAT scores, high school rank in class, and subsequent courses and grades achieved by students in order to evaluate various predictors of college success? Would you want to take steps to safeguard the security of the downloaded file? Would you place a time limit on its availability and insist that the file be erased at a certain point?

What about the faculty committee studying fraternities which wants grades and disciplinary sanctions on members of certain frats downloaded to a file so that a member can analyze it? Would you not deliver the information unless you could encrypt the names and id numbers of the students involved?

Would you release to an individual faculty member a historical report of enrollments in his deparment over past decade? What if he also wants enrollment data for other departments related to, or perhaps in competition with, his own?

What if Admissions, Development, Athletics, and several academic departments all want online access to student grades in order to "keep track of" students of particular interest to them?

And what if a self-appointed faculty committee desires course enrollments by the racial background of students in order to determine whether some departments appear to be "inhospitable" to minorities?

All of these questions came up at Brown or elsewhere before the institution was prepared to respond. I suggest that you begin to develop your institutional philosophy by creating a data administration committee representing several different offices, including your University Counsel, and posing it with a series of "what if" questions such as the above.

A second important step in developing an institutional philosophy is to begin to identify where within your institution inconsistent definitions of the same or similar concepts are being used. This is a phenomenon which I call the Ivory Tower of Babel. For example, at my institution the Provost and the Dean of the College have slightly different ways of assigning departments and programs to the categories of science, social science, and humanities. Neither system agrees with the federal government's HEGIS reporting requirements. The Registrar's Office used to have yet another system, although now we use one of the above three definitions, depending on where the report is going. **Do not delude yourself that an online system will somehow automatically serve to reduce this problem!** In fact, the more computing power you have, the more possible it becomes for every officer to say, "I want it my way." One of my fondest hopes for this integrated, distributed system was that it would diminish the Tower of Babel problem on our campus. I now see that the problem is an organizational issue having nothing at all to do with technology.

In summary, developing a distributed access information system can be disillusioning when it proceeds far more slowly than initially expected and when different offices vary widely in their commitment to it. Most of the difficulties we've experienced at Brown are resource problems, such as not enough money for equipment, software, and training, and inadequate mainframe capabilities. It is tempting to blame senior administration for a lack of commitment to the project, but the setting of budgetary priorities is highly influenced by a faculty-student-administration committee which has seldom found administrative computing to be a central issue. It has been difficult to predict from year-to-year what resources will be available. Over and over again, the real needs of the project have been funded at at 50% rate, but the expectations for performance remain at the initial level.

Despite these difficulties, we are making gradual, if uneven, progress toward distributed access to information within our institution. It is taking much longer than expected, it will not lead to staff reductions, and it has so far had little impact on the information going to senior management. It has given middle and lower levels of management access to more complete and more accurate data, if they are willing to make the investment in time and training needed to exploit the system's potential. Managment Information Services, the Registrar's Office, and the undergraduate Dean's Office have found many advantages to the system. We have tried to use example, persuasion, and what direct pressure is available to us to motivate others along the way, but the benefits for many are as yet unrealized.

PROFESSIONAL PRESENTATIONS

The CAUSE86 theme, "**The Impact of Converging Information Technologies**," was addressed through forty-nine professional presentations in seven subject tracks, as well as through seven Current Issues Sessions, less formal sessions on topics of special interest. The papers on which the professional presentations were based, and summaries of the Current Issues Sessions, are included in the following pages.

CURRENT ISSUES SESSIONS

Seven scheduled sessions provided informal opportunities for conferees to meet and exchange ideas on topics of special interest or concern, selected from requests received by the CAUSE staff prior to the conference.

ARTIFICIAL INTELLIGENCE
Moderator: Thomas R. Mason
MIRA Incorporated
Minnesota, and
David Mannering
University of Kansas

CHIEF INFORMATION OFFICERS
Moderator: Joseph Catrambone
Loyola University of Chicago

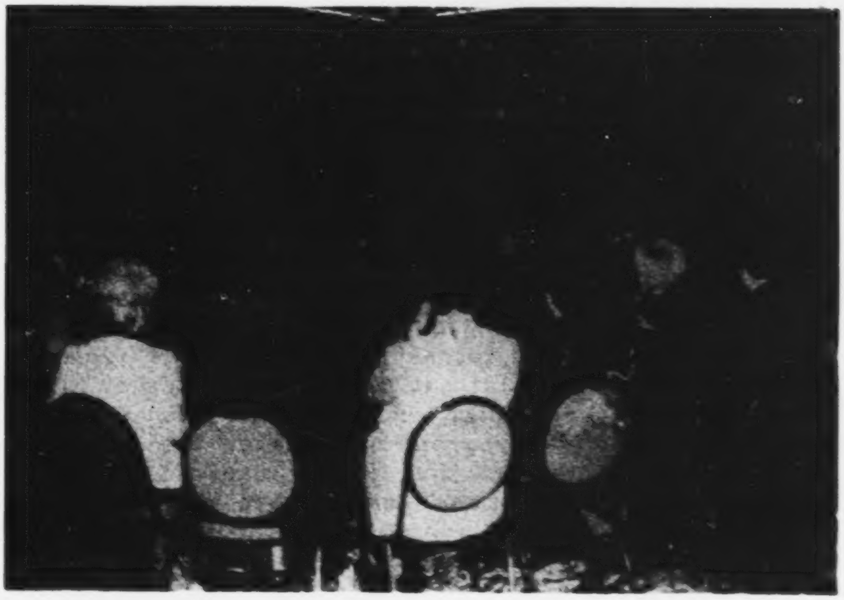
THE ELECTRONIC CAMPUS
Moderator: Reid Christenberry
University of Georgia

END-USER/DISTRIBUTED COMPUTING
Moderator: Ken Blythe
Pennsylvania State University

FOURTH-GENERATION SOFTWARE
Moderator: Marshall Drummond
Eastern Washington University

INFORMATION CENTERS
Moderator: Judith DiMarco
University of Texas
Medical Branch

LIBRARY AUTOMATION
Moderator: Jim May
California State University/
Chico



SUMMARY

Current Issues Session on Artificial Intelligence/Expert Systems

CAUSE86 Conference
Monterrey, California
December 12, 1986

Moderators:
Thomas R. Mason, MIRA Incorporated, Minneapolis
and
David Mannering, Systems Analyst, College of Liberal Arts, University of Kansas

The differences between theory-directed research in artificial intelligence and product-directed research utilizing knowledge bases and expertise to program artificial intelligence subsystems focused on particular kinds of problems were cited by Mason in opening the discussion session. Mason noted that Schank and Childers argue that expert or knowledge-based systems "are products designed to respond to demands from particular industries and are not a test of anyone's theory of human cognitive processes." (**The Cognitive Computer: On Language, Learning, and Artificial Intelligence**, 1981, p. 33.) Mainly working on the **applied** side of computer and information technologies in higher education, CAUSE members are most immediately concerned with specific applications of AI to solve particular problems in higher education administration.

Mannering described his work with development of an expert system used in the College of Liberal Arts at the University of Kansas to evaluate student records for fulfillment of degree program requirements. Applying the expertise on degree award conditions in the dean's office to the status of student progress, the expert system scans students' records to identify those with potential problems that should be called in for a counseling conference to insure timely degree completion.

Discussion from participants ranged over experimentation with expert systems to compare current expenditure patterns with budgeted allocations of funds; to improve investment strategies to produce higher endowment yields; and to integrate diverse hard data with counseling judgments for improved assessment of educational outcomes. One participant expressed doubt that high-cost expert systems are able to produce any better results than common sense using limited information. Until much more progress is made on the use of computers as models of the brain to improve our theoretical understanding of how human intelligence works, expert systems mainly are methods of managing and integrating larger and more diverse kinds of data for translation into better information and understanding.

— TRM 2/13/87

CHIEF INFORMATION OFFICERS (CIO's)
SPECIAL MEETING
FRIDAY, DECEMBER 12, 1986

CAUSE NATIONAL CONFERENCE - MONTEREY, CALIFORNIA

Presiding:
Joseph A. Catrambone
V.P., Information Systems
Loyola University of Chicago

SUMMARY OF MEETING

Current Issues Session - Chief Information Officers

The session, attended by 49 conferees, was chaired by Joseph A. Catrambone. Discussion centered on the national trend in higher education to establish a senior level position for Chief Information Officers. Almost every issue of The Chronicle of Higher Education contains an invitation for an application or nomination for a Chief Information Officer at one of the colleges or universities. Over the past three years, about 35 positions have been established identifying CIO positions with the title of Vice President or Vice Chancellor or Vice Provost for Information Systems, Information Technology, and/or Computing. In fact, these designated titles were the initial criterion used to invite participants to the first annual meeting of CIO's held in Chicago in September 1986, which established a CAUSE and EDUCOM constituent group for Chief Information Officers in higher education.

The purpose for establishing a CIO constituent group was to provide a forum for sharing experiences in understanding, utilizing and managing the ever increasing advancements in information technology in supporting the missions of our institutions. The agenda for the first annual CIO meeting in Chicago focused on organizational issues, institutional policies, strategic planning and telecommunication and networking issues. The various functions and responsibilities of CIO's were identified and discussed. The audience also participated by briefly describing the current and future organizational climate for the CIO function at their respective institutions.

The next CIO meeting of the CIO constituent group will again be held in Chicago (April 29-30, 1987) and again chaired by Mr. Catrambone and hosted by Loyola University of Chicago. Details of the next meeting will be sent to you by the CAUSE National Office.

CURRENT ISSUES SESSION SUMMARY

The Electronic Campus

Moderated by
Reid Christenberry
University of Georgia

Approximately fifty conference participants convened in this session to discuss the many issues facing college and university administrators in the successful implementation of the "electronic campus." Most of the institutions represented were in the planning or implementation stages of laying down campus-wide networks—none had a network running smoothly as yet.

Topics discussed by the group included: (1) the definition of the components of an electronic campus; (2) the motivating factors for implementing electronic document, voice and video distribution, and archival systems; (3) assessment of the current technological state of the art; (4) the appropriateness of the electronic campus to higher education operation and management; and (5) how various institutions are managing the implementation of, and assigning responsibilities related to, the electronic and campus environments.

CAUSE86 CURRENT ISSUES SESSIONS

END-USER/DISTRIBUTED COMPUTING

End-user/Distributed Computing is a popular topic, judging by the turnout at this Current Issues Session. Session moderator Ken Blythe of Penn State University opened with the proposition that end-user computing does not happen automatically. There must be a conscious effort to put the policy, procedures, training, and security mechanisms in place to encourage it to happen. He then asked if it was cost effective. A number of individuals confirmed that it was because it made end-user offices more effective. They did not have to wait on central computing priorities in order to achieve the benefits of computing. While it was not possible to provide quantitative or financial measures of this benefit, several attendees felt that end-user computing was differentiating (i.e. institutions that did it would be more successful that those that did not).

What is end-user computing? The attendees at this session held different views of end-user computing. Some saw it as decentralized computing. In fact, one school had decentralized the central administrative computing organization and replaced it by several departmental centers. Others saw end-user computing as decentralized planning, development, implementation, and use of computers. These institutions decentralized systems development while maintaining a centralized data base. The remainder saw end-user computing as encouragement and support of end-users in the use of data for operational and strategic purposes. All agreed that end-user computing changed the role of central computing. The central computing organization seemed to become more responsive through the process.

End-user computing also increases the importance of Data Administration. Decentralizing the control of computing somewhat, increases the need to control data. As end-users become more knowledgeable in data processing activities, they become more responsible for those activities. Data Administration is necessary to insure that end-users are only able to see data that they are authorized to see. End-users, on the other hand, have to become more concerned that their activities are in concert with the overall goals of the institution. There is a danger that end-user computing will lead to sub-optimal solutions in end-user offices with diminished support of institution-wide objectives. Some of the attendees maintained that end-users do not care about the overall goals of the institution as long as they meet their individual goals.

Finally,some attendees were concerned about the impact of end-user hardware (i. e. microcomputer, minicomputer) solutions on the capacity and standardization of central services. Who should determine what computers or terminals end-users should use? How do you plan for the workload that will result from the groundswell or work that will come from end-user offices? An hour is not sufficient to cover the diversity of interest generated by the end-user/distributed computing topic. It is an emerging issue that should be followed in future CAUSE conferences.

CURRENT ISSUES SESSION

FOURTH-GENERATION SOFTWARE

SESSION DESCRIPTION

The session was convened on Friday, December 12, 1986 by Dr. Marshall Drummond of Eastern Washington University. There were seventeen persons in attendance, with representatives from Yale University, University of Connecticut, Brown University, Jackson State University, Xavier University, Cleveland State University, Imperial College (London), and a Canadian university. The session began with a review of the recent "Survey of Current and Future Uses of Software Technology" study which was conducted by Dr. Drummond. The participants were polled for what information they would most like to exchange, and it was decided that the most useful format would be for each representative to describe current Fourth-Generation projects and plans at their institution. After each participant furnished the group with an overview there would be an opportunity for questions and answers.

SPECIFIC ISSUES

Issues discussed by participants included the use of FOCUS, NOMAD, PC-FOCUS, MARK IV and ORACLE for end-user computing (reports, screens, simple applications); FOCUS, CICS UFO, Software Factory products as replacements for COBOL; Eccelerator, PC-DRAW, SC-DRAW, and Pro-Kit for systems and applications design. A lively discussion ensued about the problems encountered by those who are trying to completely replace COBOL with a 4GL, and the impact on end-users who attempt to "go beyond" the reasonable limits of their 4GL.

The session concluded with a discussion about plans for the use of decentralized databases with wide-area network access coupled with SQL "Star" type products. The participants give indications of their future plans and directions regarding database and Fourth-Generatin product usage.

Current Issues Session

INFORMATION CENTERS

Moderator: Judith DiMarco
University of Texas Medical Branch

The number of information centers has grown dramatically since 1976 when IBM Canada formed the first one. Ten years later, what have we discovered about information centers? Can they (and do they) accomplish their mission? Who does the IC really serve? Do information centers meet users' expectations? What about those of the DP staff? What new challenges do DP professionals face once an IC is implemented, and what rewards can be reaped?

In this session, most attendees were in the early stages of development of information centers and were struggling with initial issues of financial support and staffing, and questions as to the mission of the IC. Representatives of several larger, well-established ICs at the University of New Mexico, Boston College, and Michigan functioned as resources at the session and answered questions for those just getting started.

Current Issues Session Summary

LIBRARY AUTOMATION

Moderator: Jim May
California State University/Chico

Approximately 20 representatives of a variety of institutions met to explore library automation questions. Initial discussion revealed a wide variety of organizational arrangements for library automation. The majority of facilities place automation under the control of the library, although in community colleges, learning centers which include libraries are often headed by media-type personnel. Several libraries have high-level administrators with advanced degrees in both library science and computer science. In some institutions no faculty or other academic representatives are involved in library planning; in others there has been a definite shift of library responsibility from administrative to academic personnel. Library planning frequently involved representatives from computing.

The group noted problems in the increasing creation of vice presidents for information systems and services: libraries fear "information czars" because this kind of move is perceived as a demotion for the library, a territoriality problem which is quite common, not unique to libraries.

Another area of concern was recognition of the need for reevaluation of personnel in the automated library. An example of the different focuses of the two disciplines is that technical people tend to concentrate on internal automation, while librarians are often more concerned with linkages with other libraries and national resources and standards. New functions require people who understand both libraries and the technology. Problems can arise when librarians without any technical training or education are put in charge of automation projects—information analysts who are not librarians have appeared in some universities (Harvard BusinessSchool, for example).

Session participants recognized other areas of concern: the competition between computing and libraries for resources; the high cost of on-line services; the requirement that library computer systems need to be an integral part of campus systems to ensure public access; the question of of charge-back of library resources, particularly since, in most cases, there is no charge for traditional library resources but charges have been exacted for access to computerized information services, particularly when they are external to the university.

Track I

Policy Issues in Higher Education

Papers in this track address the policy and organizational issues associated with the convergence of voice and data communications, computing, and video technologies in higher education—effective leadership and management of both academic and administrative computing resources, support for micro labs, computer-based instruction, networks, video instruction, management policies and concerns essential to maintaining basic control, security, integrity, and compatability of data in higher education.

Coordinator:
Mark L. Perkins
CSU/Stanislaus

Carole Barone
Syracuse University

Paul Plourde
Bentley College

Phyllis Sholtys
Northern Kentucky University

Overselling Technology: Suppose You Gave a Computer Revolution and Nobody Came?

Linda H. Fleit

EDUTECH International
120 Mountain Avenue
Bloomfield, Connecticut 06002

The bitter aftertaste that many senior administrators now have is not going to go away easily. As technology begins to settle down a bit on campus (and as we begin to think about the next steps), this bitterness remains as one of the aftermaths of the technological whirlwind, a direct result of the institution's computer people (and the vendors) having oversold the benefits of technology. This talk will discuss what happened, why it happened, why it was inevitable, and what we can do about it now to prevent it all from negatively affecting the future.

I had occasion to speak with several college presidents this past summer for a survey I was conducting on the uses of information technology in higher education, and I heard a few things that surprised me, at least, at first. A president of a large college in the Midwest, for instance, in response to a question about what his institution was planning in computing for this coming year, said, "We are planning nothing at all. We have put a moratorium on expenditures for information technology of all kinds for this academic year." Now this man runs a school that has invested heavily in computers over the last few years, both on the academic and administrative sides, and has prided himself in being foresighted and innovative, so it surprised me that, rather suddenly, he would want to put on the brakes in this important area, and possibly threaten the progress he's been able to make in a relatively short time. His response:

> "What progress? Yes, our campus is filled with equipment. Our computing budget has doubled in the last four years. Our administrators talk of integrated data bases and decision-support systems and our faculty talk of computer-managed instruction and networking. But our enrollments continue to decline by 4 percent a year. Our capital campaign is struggling to meet its goals. Our retention rate is the same as ever: lower than any of us wants it to be. We have so many tenured faculty there is no room for the younger faculty to move up. And six months ago, we accidentally overspent the financial aid budget by a million dollars. I could go on, but you get the idea. Somebody, somewhere, promised me that computers and technology would make my institution more productive, easier to manage, and more sophisticated educationally. None of these things has happened, so why continue this enormous investment?"

An overreaction, perhaps. But it gave me cause to think about things from this particular point of view, from this new attitude of reassessment, and to begin to understand that perhaps computer people and non-computer people measure progress in very different ways. While those of us who are computer people would hotly argue that technological advances have been truly revolutionary over the last few years, I wonder how many non-computer campus faculty and administrators would agree with us. Or would they be more likely to agree with our beleaguered president that, despite the expense, campus computing today is still characterized by slow development and large backlogs, decentralized data, hard-to-use applications, non-networked hardware, inexpert staff, and discontented users? The fact of the matter is that although higher education has spent literally billions of dollars on technology in recent years, many institutions are still waiting for the revolution to happen.

Thinking back on how all of this came to be, I began to recollect some of the things that we absolutely knew were going to happen by now and the expectations that we not only held ourselves, but also fostered in the minds of others. For example:

Does anyone remember the phrase "The Paperless Office?" Talk about a bandwagon! So many conference presentations, so many conferences themselves, so many vendor brochures, and so many internal memos were created on this subject that it's safe to say that the paperless office concept probably generated more paper than any other technological concept in history! Many people bought into this idea, spent zillions of dollars on hardware, software and training in anticipation of enormous benefits and cost savings, yet according to the American Association of Purchasing Agents, more filing cabinets were purchased this past year than ever before. No one really speaks much of the paperless office anymore; nor of its cousin concepts such as automated calendaring.

Here's another one: user-friendly. This idea comes in various disguises, such as "do it yourself" or "the programmer-less environment" or "end-user computing," and is still very popular today. Great expectations for users to be freed from the tyranny of the central computing facility. The end user finally acquiring his or her own instrument for automation, happily computing away in blissful isolation. Now my idea of user-friendly is a something that requires a manual less than 5 pages long, completely written in English, and has at least 25 things to try "before you call your serviceman." In other words, something slightly less complicated than my microwave oven. In fact, user-friendly computing does not exist yet, not by a long shot, and yet we continue to promote the concept as if it did.

And perhaps no greater expectations have been raised than in the area of instructional computing. Students without teachers, students without classrooms, students without books, and everything done electronically, have been part of our prediction repertoire for at least 20 years. Contrast that with the study just done at Dartmouth on the effect of technology on the process of education: "Faculty and students feel generally positive about the effect of [computers], but there is no evidence to date that the amount of learning has increased in courses using the computers." In other words, the traditional, non-computerized classroom may be just as effective for learning as the use of modern technology. The Dartmouth study is only one example of dozens of studies that have been done in the last few years, all reaching the same general conclusions.

There are many other examples I could give; such things as teleconferencing, which is a perfect example of a solution in search of a problem; as is home information retrieval services; or the educational uses of television in the classroom; or summer computer camps. All too exaggerated, all too enthusiastically promoted, and all big disappointments.

Unfortunately, while we have been parties to creating unrealistic expectations, I'm afraid that we have contributed greatly to computer people having a reputation of being unreliable, untrustworthy, usually over budget and behind schedule, and at times, capable of inflicting great harm to others at the institution. Dennis Berry of the University of Colorado gave a great talk at CAUSE a couple of years ago called, "Computer Services: Is This a Contradiction in Terms?" It was then and still is now, and the whole thing has left the important people on many of our campuses feeling disillusioned and wary.

What happened? Well, it's quite simple, really. Most of us sitting in this room are, or have been, the technology enthusiasts. Because we had a vision, and because that vision so often ran up against limited resources, institutional bureaucracy, and just plain stubborn resistance, we had to become the "sellers," if you will, of the vision. We had to be proactive, we had to be the urgers and the justifiers. And to do this, we had to believe, and to get others to believe, the Seven Great Myths of Computing. Amazingly, we are only now coming to understand that these are in fact myths, and not realities.

Myth #1: The Benefits Of Technology Can Be Quantified And The Results Of Computerization Can Be Measured. Belief in this myth is just about a requirement in environments where resources are limited, and it has led us to doing things like cost-benefit analyses, return-on-investment calculations, cost reduction and avoidance plans, and other similar, equally futile, pursuits. Remember the one about justifying the cost of a new administrative system by reducing clerical staff? Does anyone know of a place in which that actually happened? The real truth is that the benefits of automation in an educational environment are very often intangible, abstract, and immeasurable. That doesn't mean they're not there, only that we cannot apply conventional yardsticks to figure out if the expenditures have been worth it.

Myth #2: We Can Get All The Bugs Out, or, from the fairy tale by the same name, Software Can Be Perfect. This myth is so pervasive that even today, the President of the United States, in promoting the Strategic Defense Initiative, the largest and potentially most important software development project in history, is laboring under the assumption that we can actually depend on the programming that will be done for it to protect human life from nuclear weapons. Regardless of how you feel about this politically, I don't believe there is a really knowledgeable person in the world who can assert that this software will work. I wonder if deep down inside, President Reagan was thinking of this as a fantasy movie rather than a reality when he dubbed the project "Star Wars". The reality is that contrary to what the great majority of professional programmers would like to believe - and would like the rest of the world to believe - programming is still an inexact, arcane, basically unmanageable process, fraught with guesswork, unforeseen delays and a great deal of wishful thinking.

Myth #3: We Know And Understand What Other People Do For A Living. This myth is fairly widespread, but nowhere more prevalent than in the area of decision-support systems. I'm sure you all know the Three Universal Lies: the first is that the check is in the mail, the second is I swear the light was green, officer, and the third is I'm going to design a decision support system for you. Here we assume we understand how a person actually makes a decision, what information is important in that process, and how to deliver the information to the decision-maker. These are questions that behavioral psychologists have been struggling with for decades, and yet somehow, many of us feel that just by using a computer in the process, we'll solve the problem. Many, many information systems projects have been undertaken with the promise of providing decision support to the president and other administrators at the institution, and many, many of these are still struggling mightily to do just that.

Myth #4: "All We Have To Do Is ...." I call this one the seductiveness of simplicity. If only it were that easy! For us to believe that anything about technology is easy is to ignore the great unknowns, ignore all of the inherent risks and the hidden costs, and pretend that we can plan away the surprises. All we have to do is hook up the PC's in the Registrar's Office to a local area network and he'll be able to produce his own transcripts. All we have to do is talk to the people at DEC and have them lend us a disk drive and we'll be all set. All we have to do is hire every senior systems programmer on the east coast and we can get MVS installed by February. But it's never that simple. We underestimate. We underbudget. We fail to foresee all of the problems. And we fail to appreciate all of the risks.

Myth #5: There Are Standards To Follow. Now the person in this picture is ordinarily not a cranky person. But he was under the impression that he could actually depend on his computer system to not blow up in his face. We all want very badly to believe there are standards to follow, and that every time we go to do something, we're not pioneering and blazing new trails. But for a lot of the really important things we do, it's just not true. A corollary myth is that we can learn from the mistakes of others. Actually, we can learn, sometimes, but only if we know what was the same and what was different about the situation we're trying to learn from. Can East Mt. Olympus College, with an enrollment of 1,800 and a computing budget of $736,000 a year, really learn anything substantive from Carnegie Mellon or Dartmouth or Brown? Are there any role models?

Myth #6: Solving The Technical Problem Means Solving The Problem. In other words, we can pretty much ignore human psychology, and put the technology before the people. This myth alone has led to more disasters than any of the others combined. We ignore human psychology every time we design a training program that puts vice presidents in with clerical people, every time we program an online error message to say "SDF32: INPUT NOT CONFORMING. REINPUT. ERROR WRITING DISK BLOCK 147," every time we think we can replace the unspoken human interaction that takes place at a business meeting with a video teleconference, and every time we expect an administrator to do work at a terminal that he or she thinks is better done by a secretary.

Myth #7: The Workload Of Our Computer Center Will Be Significantly Reduced With X Technology. Replace "X" with almost anything: a data base management system, users having microcomputers, you name it. Actually, this is really a hope more than a myth, but I include it here, because it's been around so long, and is so persistent, sort of like a flu virus. If anything, of course, the effect of new technology has been quite the opposite.

We all bought into these myths, more or less. And since we were the committed, we were the enthusiasts for technology, we, wittingly or otherwise, sold them to others. In fact, it was inevitable that it happen this way. A counterbalance to the newness of it all was required, a period of salesmanship was needed, and a persuasive posture had to be taken. But the unfortunate result is that many people on are campuses are left with this lingering aftertaste, ranging from outright distrust in some cases to mild skepticism in others, but on the whole, a great deal of wariness which could, in fact, threaten the real progress our institutions need to be making.

The real question is what to do now. Whether we accept the inevitability of our situation or not, we still have to cope with it, and we need to know how to dispel the doubts. Confidence in technology has to be restored. None of the old ways are really needed anymore. We don't have to exaggerate anymore, and we don't have to put up with others (like vendors, for instance) doing it either.

The first thing we have to do is to introduce some reality into the so-called revolution by renouncing the Seven Great

Myths. We need to educate the people on our campuses about the intangible, but fully worthwhile, benefits of technology, about the bugs in the software we write as well as the software we buy. We need to ask them to be patient about obtaining computer support in making important decisions, and we need to explain that none of this is easy. We have to tell them about the risks and be realistic about the rewards.

Second, we have to distinguish between what is genuinely revolutionary and what is not. There are certainly enough things about computing on our campuses which are truly revolutionary in and of themselves, so as not to have to continue to exaggerate the benefits of every aspect. For one thing, the technology itself is truly revolutionary. Just looking at it from the aspect of the breakthroughs that each of the hardware generations have represented, the genius and creativity that have gone into such things as the Apple Macintosh and the Kurzweil reading machine, the graphics that are possible today, and all the rest of it, there is much to be amazed by.

The costs too, have gone through a truly revolutionary decline, although here again, it's very important to distinguish between the price/performance ratio and the total cost of campus computing. While the former has declined, the latter has risen dramatically.

The ubiquity of the microcomputer has brought about its own revolution of sorts. The numbers of people who have had exposure to computing compared with five years ago is staggering. This is especially true for students, where the number of entering freshmen who report having had a computer experience of some kind in high school is virtually making the need for computer literacy programs at the college level quickly vanish.

The third thing we have to do is to agree on the goals (and the measurement and the terminology) that we're going to use for campus computing. One of the biggest problems we face is that computer people and non-computer people tend to define things differently. In reaching an agreement, we have to focus on the institution itself, and to use technology to support its goals, not the goals of the computer center. No more technology for its own sake; we need to agree on what we mean by terms such as "increased productivity" and "more effective learning." We need to move away from the world in which the computer people continue to believe that end users don't know what they want, but they want it yesterday, and in which the users contend that the computer people are more interested in exploiting the latest technology than in solving the users' problems. We need to agree on what we mean by the "worth" of a technological advancement.

We need to have our campus decision-makers understand that the student information system that has taken two and a half years to install will, in fact, eventually produce the information they are looking for, but that it has to work on the day-to-day operational level in the registrar's office first. The foundation has to be built before the information they are looking for reaches a more strategic, and less routine, level.

And we have to get people like our unhappy president believing once again that technology really can contribute to the mission of his institution, and not just make it a more expensive place to run.

Last, but perhaps most important of all, we need to treat technological innovation differently than we have in the past. I'll give you an example of a good opportunity we have before us right now to do it all differently and to really do it right. Let's take a look for a moment at fourth generation languages (or 4GL's, as they are known) and their role in end-user computing.

End user computing is one of those motherhood and apple pie phrases that we all know is good, but when it comes to defining what it is or how we get there, we don't have a real uniformity of opinion. But let's say for the moment that end user computing is a way for non-technical people to be able to use campus computing power to acquire and manipulate information to achieve some results. If we go with that definition, then it looks as if the concept of a fourth-generation language may be just the ticket. It allows us to describe what it is we want from the computer, as opposed to the earlier-generation, procedural languages that forced us to specify, in agonizing detail, how to get what we wanted. So the fourth generation is non-procedural, more English-language-like, may even be semi-user-friendly, and focuses on the "what," rather than the "how." Sounds great.

Now it goes without saying that 4GL's are not cheap, and it's not something we can just sneak in under the desk. So we need to get budget approval, and if we were to go about this in the usual fashion, we might be inclined to say something like "having a 4th generation language will reduce the programming backlog in the computer center because end users will be able to do their own reports." Or, "having a 4th generation language will give end users greater control over their own data, and will let them do interesting things they can't do now." Or, (this is one of my favorites) "having a 4th generation language is 'the wave of the future' and if we don't get one, we will have only dinosaur computer programs, running in a dinosaur computer center." The implication is, of course, if you don't stay on the leading edge, you will fall so hopelessly behind that you will eventually go the way of the pterodactyl. So we use these and other favorite phrases to get the budget approval; we bring in a 4th generation language, and what happens?

The first thing we notice is that the programming backlog in the computer center does, indeed, get shorter. That's because we take this backlog and sort it into department order, and transfer it out to the departments, thereby creating department backlogs. So now the people in the Registrar's Office, who, as we all know, have lots of free time on their hands, can start writing their own programs.

Oh wait - did I say "programs?" You're not really supposed to say that when referring to the collection of 4GL instructions that is put together to run a report or whatever; too reminiscent of COBOL or PL/1. But, in fact, that is the very next thing we discover! These sets of instructions are really programs in disguise, and to create them, one needs some skill in logic, and attention to detail, and debugging, and a whole lot of other things that suggest they may really be closer to earlier-generation computer languages than we had thought.

And let's not forget about maintenance. Talk about history repeating itself! Computer centers have learned very difficult lessons over the years about program structure and documentation and maintainability. The structural components of COBOL and other 3rd generation languages came at great cost and with good reason, and now we have end users learning the very same lessons in the very same way - by writing unstructured, undocumented and unmaintainable programs!

Then add to these problems the training issues, the technical effort involved in making the data base components available to software other than the traditional applications programs, the enormous machine resources required, issues about security and the integrity of the data, and we end up with a situation that is not as clearly beneficial as it originally seemed to be. And by the way, on the average, 60 to 70 percent of the programming effort in most university computer centers is devoted to maintaining existing software - written in the dinosaur programming language - and unless the institution is willing to undergo a complete rewrite and overhaul (which is fairly unlikely), the old language is going to be around for a good long while anyway.

Now, all of this is not to say that having a fourth generation language is not a good idea. Actually, it's a very good idea, but it needs to be approached realistically, and with the appropriate set of expectations. Such things as having the computer staff begin to use the 4GL for selected applications instead of COBOL can produce some nice results. They may not be as dramatic as reducing the programming backlog overnight, but they will be there, and they will be real. Using a 4GL for prototyping, so that users and computer people can communicate easily and more quickly about what a system is supposed to do, can pay off in the long run. Putting one user on under a pilot program, and having the 4GL used to create programs of 500 lines or fewer can minimize some of the costs, and thereby better justify the benefits. The point is that the merits of a 4GL can stand on their own; they don't need to be exaggerated. And if the environment demands that they do, then we have to go back and work harder at dispelling those myths.

We face similar situations in the desktop publishing area (I don't mean to pick on Xerox with this slide, but I think you get the idea. Actually, maybe I do mean to pick on Xerox a little, just for having the audacity to suggest that Leonardo da Vinci would have said anything even like this), and in the concept of information centers, and a whole host of other, promising happpenings.

Perhaps the most useful thing we can do now is to change the timing and the schedule a bit, and the focus from short-term to long-term. Perhaps now is the time to make a distinction between changes and improvements and begin to think of ways that we can protect the heavy investments we have already made. We have an awful lot of technology in our schools; I have to believe that we can get better results from what's there than many of us already are getting. More and faster doesn't necessarily translate into better, better productivity, better learning, better quality of campus life. But if we take time to digest things a bit, to let the implications and the unknowns begin to make themselves known and understood, we have a much better chance of realizing some of those benefits we've been talking about for so many years.

The benefits don't come about as a result of isolated technological changes; they can come about when other changes are made that allow us to take better advantage of the technology. Such things as changes in organizational structure, for instance, or administrative style, or curriculum content and pacing, or the distribution of power and control all have to be considered if the real benefits are ever to be accrued. But these changes take much longer, especially in the slower pace of higher education.

The important revolution in higher education will happen in the human arena, not the technological one. The theme of this conference is the impact of converging technologies. If we expect technologies to converge on our campuses without crises, without misspent resources, and without a lot of casualties, we must do a better job of presenting technological benefits in a more honest and realistic way to those who are technologically unsophisticated. We have to get rid of the frustrating and traditional mismatch between expectations and reality. The decision-makers have to have the chance to make informed judgements, without the hype, without the emotional exaggerations of the past, and with more than a lip-service understanding of the risks involved.

Selling the President on the Computing Plan: Strategic Funds Programming

John L. Green
President
Washburn University

Presidents of colleges and universities want to make certain that the planning in their institution is done realistically, objectively, and effectively. Strategic funds programming is a technique developed to enhance the planning process by linking objective decision making with resource-allocation decisions (i.e., which strategies should be funded). Strategic funds programming balances the need to maintain current operations with the financial needs of new strategies. It also provides a safeguard for administrators who become so enamored with future opportunities that they fail to provide adequate support for current operations.

SELLING THE PRESIDENT ON THE COMPUTING PLAN: STRATEGIC FUNDS PROGRAMMING

After World War II, colleges and universities (institutions) began using electronic data processing (EDP) to assist them in managing the processing of data both in administrative operations and in research operations. The technological advancement of EDP involved constant changes in the size of the hardware and in its capabilities.

Presidents of these institutions were asked almost on an annual basis to provide more funding for EDP operations either in the form of new equipment or upgrading of existing equipment. As the research activities of institutions learned of the computer capabilities, the proliferation of computer "needs" became gargantuan. The task of analyzing needs and making decisions on computer hardware and software purchases seemed to become an everyday occurrence.

What presidents found necessary to have was a well thought-out plan for the academic and administrative computing needs of the institution. Once this is accomplished, the question becomes one of how to sell the president on the well thought out computer needs of the institution. From a president's perspective, there are three critical factors that need to be addressed in an institutional plan:

1. What are the total financial needs of the institution in a prioritized format?

2. What are the total financial resources available to the institution to satisfy the needs of the institution?

3. What are the alternative strategies to satisfy each of the institutional needs and is there a mechanism to determine the best strategy concerning the actual allocation of scarce resources?

Some of the more effective ways of determining the needs of an institution are strategic planning, zero-based budget analysis, formulas, educational and administrative standards, comparative surveys, and competitive analysis. Of all the techniques, the most effective is strategic planning.

The president also needs to have "full" knowledge of the available financial resources in the institution. Too often presidents are not given accurate estimates of tuition revenue or they are kept in the dark on idle fund investment income, endowment earnings income, unrestricted gifts available for institutional use, excess auxiliary enterprise revenues, funding available from position turnovers, borrowing capability and a host of miscellaneous funding sources. The president therefore, is given not only an inexhaustible list of institutional needs, but also a variety of alternative sources of funding to satisfy the needs.

Once the needs are known in priority order, and once the available resources have been identified to satisfy as many of these needs as possible, the president is close to being able to make allocation decisions. What remains is the capability of being able to review alternative strategies that are designed to satisfy institutional needs. This capability can be found in "strategic funding programming."

Introduction to Strategic Funds Programming (SFP)

Strategic funds programming (SFP) is a technique that strengthens the decision-making process when funds are being allocated to specific programs. Two important aspects of SFP are:

1. It provides a way to determine the amount of strategic funds that are available.
2. It bases the allocation of strategic funds on a calculated "high probability of success" factor.

Before SFP can be used, the total needs of an institution must already have been identified and expenditure priorities set. This means that a system such as strategic planning has been used to identify the institution's needs and that alternative strategies associated with fulfilling each need have been developed.

To be able to determine the amount of strategic funds available, four items are needed:

1. Current Funds Operating Budget (Exhibit A)
2. Balance Sheet (Exhibit B)
3. Financial Ratios (Exhibit B)
4. Source and Use of Funds Statement (Exhibit C)
5. Strategic Funds Programming Worksheet (Exhibit D)

The development of a budget each year usually involves the identification of "baseline funding" first, and second the identification of strategic funding. Baseline funding covers the on-going maintenance items of an institution such as salary increases, employee benefit costs, inflation, and utility charges. Strategic funding, on the other hand, covers discretionary items such as program enrichment, salary enhancement, and new programs, etc.

Information from the current funds operating budget (Exhibit A) is used in SFP to complete the strategic funds programming worksheet (Exhibit B). Information from the balance sheet (Exhibit B) is used to develop the source and use of funds statement (Exhibit D). Financial ratios (bottom of Exhibit B) are used to calculate the debt limitation which effects the amount of funds available from additional borrowing.

The source and use of funds statement (Exhibit C) is an excellent exercise to see year to year where increases and decreases in funds flow are taking place. For example, if accounts receivable had not increased by $200,000 in 1985 (see Exhibit C), the XYZ University would have had additional cash available in its funds flow. With the information from the source and use of funds statement, the institution can plan to maximize its flow of funds.

Once the amount of strategic funds that is available has been determined (see Exhibit D), the matter of maximizing the use of these funds during the allocation process is addressed in SFP. This requires having the strategic needs of the institution identified in the form of stated goals to be achieved, strategic issues to be resolved, and alternative strategies to be carried out for both goals and issues. Alternative strategies that will be the most successful are then chosen by using cost-benefit analysis. All of these considerations are included in the strategic funds programming case examples which follows.

Exhibit A

XYZ University
Budgeted Current Fund Operations, 1986 FY

Educational and General Revenue	
Tuition	$ 6,000,000
State Appropriation	5,000,000
Sales and Services	300,000
Miscellaneous Income	50,000
Total	11,350,000
Educational and General Expenditures	
Instruction	$ 7,000,000
Research	100,000
Community Service	75,000
Academic Support	775,000
Institutional Support	715,000
Physical Plant	2,010,000
Total	10,675,000
Excess of Revenue Over Expenditures	$ 675,000

Note: (1) This is a simplified version of a revenue/expenditure budget in order to provide a clear example. Strategic funds programming can also be used for complex institutions.

(2) Baseline requirements are included in this budget, but no strategic funds have been allocated.

Exhibit B

XYZ University
Balance Sheet, F.Y. 1983-84 and 1984-85

Assets (1985)		Liabilities (1985)	
Cash	360,000	Accounts Payable	800,000
Accounts Receivable	400,000	Other Short-term Liabilities	700,000
Inventories	200,000	Long-term debt	14,500,000
Property, plant and equipment	17,540,000	Fund balance	2,800,000
Other	300,000		
Total	18,800,000	Total	18,800,000

Assets (1984)		Liabilities (1984)	
Cash	400,000	Accounts Payable	600,000
Accounts Receivable	200,000	Other Short-term Liabilities	500,000
Inventories	400,000	Long-term debt	14,400,000
Property, plant and equipment	16,440,000	Fund balance	2,500,000
Other	560,000		
Total	18,000,000	Total	18,000,000

Note: This is a simplified version of a balance sheet in order to provide a clear example. Strategic funds programming can also be used for complex institutions.

Ratios

$$\text{Long-Term Debt to Fund Balance Ratio} = \frac{\text{Long-Term Debt}}{\text{Fund Balance}}$$

$$\text{or } \frac{14{,}500{,}000}{2{,}800{,}000} = 5.2$$

Exhibit C

XYZ University
Source and Use of Funds (1984-1985 FY)

		Sources of Funds		Uses of Funds
Assets:				
Cash	D*	$ 40,000	I*	
Accounts receivable	D		I	200,000
Inventories	D	200,000	I	
Fixed Assets	D		I	1,100,000
Other Investments & Receivables	D	260,000	I	
Liabilities and Fund Balance:				
Accounts Payable	I	200,000	D	
Other Short-term liabilities	I	200,000	D	
Long-term debt	I	100,000	D	
Fund balance	I	300,000	D	
Total		1,300,000		1,300,000

---

* D= Decrease; I = increase

Note: This information was obtained from the Balance Sheet.

Case Example - Strategic Funds Programming

Institution XYZ has the following goal it would like to achieve in connection with its academic computer center:

> To have all students take a college level basic computing skills course effective 1989, in order to be eligible to earn their baccalaureate degree.

Four alternative strategies have been developed to achieve this goal in the computer center:

1. Upgrade Prime 9750 computer to Prime 9955 computer which would be able to support up to 250 terminals and/or microcomputers.
2. Install a second Prime superminicomputer to augment the capacity of the first computer. Using a data switch, the two computers would support 250 terminals.
3. Acquire 250 microcomputers to equip microcomputer laboratories.
4. Replace Prime 9750 with a Convex C-1 minisupercomputer which could support up to 500 terminals and provide greater computing capacity for faculty research.

The financial impact on each strategy is shown below along with the baseline funding that has already been provided in the 1986 budget (Exhibit A).

Academic Computer Center

EXPENSE CATEGORY	BASELINE FUNDING	STRATEGIES #1	#2	#3	#4
Salaries					
salaried staff FTE	0	1	1	3	2
salaried staff $	15,000*	20,000	20,000	60,000	40,000
hourly staff FTE	0	1	1	3	1
hourly staff $	5,000*	20,000	20,000	60,000	20,000
student workers FTE	2	2	2	4	2
student workers $	7,000	7,000	7,000	14,000	7,000
Supplies $	1,000	6,000	6,000	4,000	8,000
Maintenance $	4,000	20,000	50,000	60,000	25,000
Equipment Purchase $	10,000	250,000	360,000	405,000	600,000
Travel $	1,000	1,000	1,000	4,000	2,000
Software $	7,000	10,000	40,000	50,000	60,000
Total	50,000	334,000	504,000	657,000	762,000

---

* Salary Increases

The strategic funds programming worksheet (Exhibit D) can now be completed. The current funds budget for 1986 shows an excess of revenue over expenditures of $675,000 which is the first item in the strategic funds programming worksheet. Transfers of $100,000 from current funds are contemplated, so this leaves a balance of $575,000 strategic funds available for allocation considerations. As noted in Exhibit D, the decision has been made to allocate $250,000 of the strategic funds generated from current operations, to the academic computer center.

Exhibit D

XYZ University
Strategic Funds Programming Worksheet

Estimated Total Funds Available:	For Entire University	Allocated to Computing	Allocated to Other Programs
Current fund budget (1986)	$ 675,000		
Transfers	-100,000		
Estimated funds flow from operations	$ 575,000	$ 250,000	$ 325,000
Augmented Debt:			
Increase in fund balance (1985 FY)	$ 100,000		
L.T. debt to fund balance ratio of 5.2	$ 520,000	$ 150,000	$ 370,000
Expanded Debt:			
Newly negotiated L.T. debt/fund balance ratio	5.4		
Minus current L.T. debt/fund balance ratio	5.2		
Expanded debt factor (Long Term)	+ 0.2		
Fund balance of $2,800,000 multiplied by expanded debt factor	$ 560,000	$ 158,000	$ 402,000
Total Funds Available	$1,655,000	$ 558,000	$1,097,000

Augmented debt was calculated by taking the increase in fund balance for 1985 FY of $100,000 and applying the existing long-term debt to fund balance ratio of 5.2 to this amount which amounts to $520,000 that could be borrowed as augmented debt. Of this amount, the academic computer center received an allocation of $150,000.

Finally, a newly negotiated long-term debt to fund balance ratio of 5.4 was approved which means that debt can be expanded by 20 percent or $560,000. Of this amount, $158,000 was allocated to the computer center for a total allocation of $558,000.

The next step involves matching the available strategic funds with the most successful strategy as shown below in the analysis of funds use statement:

Analysis of Funds Use

	From Internal Funds	From Internal Funds Plus Augmented Debt	From Internal Funds, & Augmented Debt, & Expanded Debt
Strategic funds available	$250,000	$400,00	$558,000
Option A, $334,000 required	can do 75% of project	can do with $66,000 unused	can do with $224,000 unused
Option B, $504,000 required	can not do full project	can do 79% of project	can do with $54,000 unused
Option C, $657,000 required	can not do full project	can not do full project	can do 85% of project
Option D, $762,000 required	can not do full project	can not do full project	can do 73% of project

The question now becomes which strategy is the best one to implement. To determine the best strategy, cost-benefit analysis can be used. A strategy can be efficient in the sense of supporting the achievement of a goal or resolving a strategic issue at the lowest possible cost, but it may not be a good choice from the standpoint of benefits derived for the amount of costs incurred.

The basic purpose of a cost-benefit analysis is to determine whether the benefits of an alternative strategy exceed the cost and to choose the alternative that provides the maximum net benefit. In this case example, the benefit issue is:

> "To what extent does required computing skills and ready computer access affect a student's decision on which institution to attend."

There are both tangible and intangible benefits to consider. Because it is more difficult to derive a monetary representation for intangible benefits, strategic alternatives need to be examined in terms of tangible benefits on the one hand and tangible and intangible benefits jointly on the other hand. The following tangible and intangible benefits have been identified.

1. Possible Tangible Benefits:
   a. Increased enrollment due to marketing the University as an institution offering students unique educational programs (required computer skills).
   b. Better prepared graduates who will be able to enter the job market.
   c. Increased student retention as students are inclined to stay with a system they have learned to use.
   d. Increased faculty teaching effectiveness since faculty can be assured that students have basic computer skills.
   e. More effective utilization of computer resources (economies of scale).
   f. Support for faculty research could be increased.
2. Possible Intangible Benefits:
   a. Public perception of the University as an institution incorporating technological change into the curriculum.
   b. University gains leadership position in the use of computers by the total student body.
   c. Improved student and faculty morale as they perceive that the University is making a commitment to improve the learning environment.

The next step is to identify the benefit assumptions associated with the tangible and intangible benefits for each strategy:

	Benefits	
	Tangible	Intangible
Strategy 1:	2.3% growth in tuition revenue.	Improved fund raising.
Strategy 2:	2.3% growth in tuition revenue.	Improved fund raising.
Strategy 3:	1.8% growth in tuition revenue.	Improved fund raising.
Strategy 4:	4.6% growth in tuition revenue.	Improved fund raising.

From these assumptions of tangible and intangible benefits, the following incremental benefit calculations are made:

Incremental Benefit Calculations

	Using These Alternative Strategies			
	1	2	3	4
Tangible	$140,000	$140,000	$112,000	$280,000
Intangible	100,000	100,000	70,000	400,000
Incremental cost spread over 4 years	83,500	126,000	164,000	190,000
Net Incremental Value:				
Tangible alone(1)	56,600	14,000	-52,000	90,000
Tangible and intangible(2)	156,500	114,000	18,000	490,000

---

(1) Calculated by taking tangible benefit amount less incremental cost.

(2) Calculated by taking tangible benefit amount less incremental cost plus intangible benefit.

While strategy #4 has the highest tangible and intangible value, the funds available for each strategy must be considered as well as which strategy has the highest potential to be responsive to the goal to be achieved. This brings the strategic funds programming to the next step, the development of a scale to measure the level of support for each strategy. In this example, the scale used is as follows:

Level of Support for the Strategy	Scale
Strong	.8 to 1.0
Moderate	.5 to .79
Weak	.0 to .49

Alternatives that have positive net benefits should be compared to determine the alternative that offers the greatest value. The maximum value of each alternative is obtained from the product of those factors that ultimately determine the success or failure of a strategy.

The three criterion used to measure the success of each strategy in this example are as follows:

1. Impact:
    a. Long-run financial gain
    b. Number of people affected
    c. Multiple needs served
    d. Ability to accomplish goal
2. Implementation:
    a. Ability to estimate implementation cost
    b. Degree of acceptance
    c. Ability to plan implementation
    d. Degree of certainty of implementation
    e. Resources available
3. Urgency:
    a. Value of proposed strategy
    b. Political support expected (internal)
    c. Criticality or need for a solution
    d. Environmental demands that favor solution

The calculation of the maximum potential for each strategy is calculated as the final step:

Maximum Potential

	CRITERION									
Alternative Strategy	Impact	Implementation	X	Urgency	=	Likelihood of success	X	$ level	=	Maximum potential
1	.90	.95		.85		.73		$156,500		$114,000
2	.85	.95		.85		.69		114,000		79,000
3	.80	.9		.9		.65		18,000		12,000
4	.99	.75		.8		.59		490,000		289,000

While alternative strategy #4 has the greatest maximum potential, only part of the project can be implemented with the funds available. Therefore, strategy #1 is the one chosen because it has relative high potential and it is affordable.

By Dr. John L. Green, Jr., President
Washburn University

A PRELIMINARY REPORT OF INSTITUTIONAL EXPERIENCE WITH MIS SOFTWARE

DR. PAUL J. PLOURDE

BENTLEY COLLEGE

WALTHAM, MASSACHUSETTS

The results of a survey of that was administered to 458 colleges and universities that utilize comprehensive MIS software packages are reported in this paper. The primary focus is on the experience of users with implementation and use of the software both from the perspective of the technical staff and the end user. Some of the topics covered include: reasons and objectives of acquisition, the impact on the application development and implementation cycle, and operational issues such as user involvement, implementation effort and system tailoring.

During the past ten years, an increasing number of colleges and universities have made the decision to acquire a comprehensive MIS software package to satisfy the administrative systems needs of the institution. Three years ago, this author sent a questionnaire to over thirty vendors of software packages that purported to provide aa total MIS solution for colleges and universities. The goal was to have the vendors identify the modules that they provided, the environments in which the software functioned and identify their current users. With this informaton, the intent was to send a questionnaire to each user to determine their satisfaction with this particular approach to providing the institution with MIS support.

Unfortunately, the study did not progress beyond the stage of identifying vendors and users at that time. In the fall of 1986, the study was revived with a view to publishing a monograph that might be useful in assisting individuals at institutions that were contemplating acquiring such software. The same survey was sent to vendors although there were several new companies in the marketplace and a number were no longer marketing the software that was available three years earlier.

The next step was the development of a questionnaire that was sent to 458 institutions that were identified by vendors, through my personal contacts and consulting and through a continuing review of The Chronicle of Higher Education and internal and external vendor publications.

The survey was administered in October of 1986 and at the time of this writing the response rate was 21 percent. A second mailing is scheduled to non-respondents in January of 1987. The final version of the instrument is attached to this paper as pages 8 thru 10.

One of the questions sought to determine the previous mode of providing administrative computing service and in response 43.6% previously did in-house software development, 12.8% used a service bureau, 3.2% participated in aconsortium, a like percentage used a regional faciltity, 6.4% used another package, while 30.8% used manual systems

The survey sought to determine why the software was selected, the objectives they sought to satisfy and whether or not those specified objectives were satisfied. The fact that the software was comprehensive or functionally complete was identified by 13.6% of respondents as the reason for selection and was most frequently mentioned reason in a question that was open ended that is the respondent provided the response. Another 12.6% indicated cost as the primary factor, 9.7% noted ease of use, 8.7% indicated the software's flexibility, 7.8% identified the importance of the customer base and recommendations and 6.8% viewed the integration of the college's functions as the primary reason for selection.

Another open-ended question dealt with the two most important objectives to be satisfied by the use of this software package. Data integration was specified by 17.6% of respondents, 12.7% sought to improve daily operations, 7.8% wanted to provide an MIS/DSS, another 7.8% wanted to provide an on-line system while 6.9% were seeking a user friendly system.

The survey sought to determine the importance of the hardware in making the decision. In response, 18.2% said it was crucial, 29.0% said it was very important, 27.3% said it was important, while 18.2% said that it was somewhat important and only 7.3% indicated that it was unimportant.

The questions of the amount of time for evaluation and to get the system operational resulted in the following responses:

TIME	EVALUATION	IMPLEMENTATION
6 months or less	43.2%	19.2%
12 months or less	31.4%	17.3%
18 months or less	15.7%	21.2%
24 months or less	9.7%	32.7%
36 months or less		9.6%

Concerning the number of computer professionals on the implementation project 14.5% indicated one person, 43.6% noted between 1 and 2, 18.2% noted between 2 and 3, 3.6% said 3 to 4, 7,3% said 4 to 5, 3.6% said 5 to 6, 5.5% 6 to 8 and 3.6% said that than eight people were involved.

The issue of vendor support is always a key question when one considers software acquisition and vendor involvement seems crucial in the early stages since 66% utilized the vendor for on-site training and virtually all users had vendor support to install the modules. Forty-nine percent used one month or less of support, 23.1% used two months, 10.3 used 3 months, another 10.3% used 4 to 6 months and 7.7% used more than 6 months.

Whether or not to modify the software is another key question facing prospective users and 71.4% modify the software once it is installed and an an even greater percentage acquire the source code (85.7%). Regarding the question of who modifies the software, 69.1% indicated that the computer center staff modifies the application software, 41.1% said the vendor does the modifications and 3.6% indicated that either the users or some other group does. The percentage exceeds 100 since multiple responses were allowed.

The survey sought to determine the extent of user involvement in making changes to screens and reports as distinct from the application code refrenced above. Eighty percent of the respondents said that users created their own reports and thirty percent said that users created their own screens.

My initial hypothesis was that projects of this sort usually start out with an underestimation of the budget requirement. The findings don't seem to lend overwhelming support to this notion since only 39% indicated that they were over budget and 24% said they were underbudget and 37% indicated that costs were equal to the budget. Of perhaps more importance was the amount of the total budget for the acquisition and implementation. Twenty seven percent said costs were between $300,000 and $400,00, 20.5 said the range was $200,000 to $300,000, and the same percentage said it was between $100,000 and $200,000 while 2.3% noted that it was less than $100,000. At the other extreme, 11.3% said costs exceeded one million dollars, a similar percentage indicated costs between $500,000 and $1,000,000 and 11.4% said the range was $400,000 to $500,000.

Considering the extent of these expentidures, the people commitment and user involvement a logical question is to ask whether or not the original original objectives were satisfied. In response, 27.3% indicated that they had been satisfied completely, while 58.2% responded that they were satisfied to a considerable extent, 12.7% said that they were satisfied to a certain extent and 1.8% indicated that none were satisfied.

This high level of satisfaction is further supported by the response to on whether the implementation and use of this package was a success or a failure at their institution. Twenty three percent indicated that it was an overwhelming success, 59% said it was highly successful, 14% cited that it was somewhat successful and less than 4% said that it was a dismal failure. The major reasons for success that respondents wrote-in were user involvement (12.3%), vendor support (8.2%),and better communication amongst users (7.2%).

When there were perceived problems, lack of user training was the reason most mentioned (11.3%) and the lack of qua;ified DP personnel was close behind with 10.3%. Problems with data conversion (9.2%), user resistance (8.2%), bugs (7.2%) and lack of or poor documentation (6.2%) were other problem areas cited. It is interesting to note that problems or success were seldom due to lack of technical søphistication or features and were most often centered on people oriented issues.

Perhaps the ultimate measure of satisfaction is whether the institution would acquire the same software or recommend it to others. In response sixty eight percent said that they would acquire the same software

15% would acquire another package and only 10% would develop their own software. Similarly, institutions reflect their satisfaction by indicating that they would recommend the siftware to others. Thirty six percent would do so without quallification and 43% would give a strong recommendation. Only 19% would qualify their recommendation and a miniscule 2% would not recommend the software to others.

In summary the findings indicate that users select software inlarge measure because of the hardware on which it functions, they feel quite positive about their experience, they modify the software, reports and screens extensively and they feel that it reduces the time to install applications substantially.

In terms of advice to prospective users of these various MIS packages users have a number of excellent suggestions as follows:

* establish a philosophy of end user involvement and ownership
* insure that management, the end-user and DP are involved
* commit to an integrated system and acquire many modules
* buy flexible software that supports this integration
* identify software needs before evaluating
* perform live site visits
* buy enough hardware up front
* emphasize user training
* don't buy futures or become a BETA site for hardware or software
* have a realistic budget and implementation schedule

The next steps in this study call for analysis of the response to the second mailing and a follow up with specific queries to respondents.

MIS SOFTWARE USER SURVEY

RESPONDENT NAME: ______________________________ **TITLE:** ______________________

INSTITUTION NAME: ____

ADDRESS: ____ **STATE:** ______ **ZIP:** _____

1. MIS Software Name: ________________ Vendor: ____________________________

   Year Installed: _________ If no longer in use, year terminated: ______

2. Computer system(s) on which this software has been implemented:

   a) Computer __________ Year _______ b) Computer ___________ Year _________

   b) How significant was the hardware in making the decision?

Unimportant	Somewhat	Important	Very Important	Crucial
1	2	3	4	5

3. Please identify and rank order, the two most important reasons why this software was selected:

   1. ________________________ 2. ________________________

4. Please identify and rank order the two most important objectives to be satisfied by the use of the software package:

   1. __________________________ 2. __________________________

5. To what extent have these objectives been satisfied?

   1 none 2 to a certain extent 3 considerably 4 completely

6. How much time was involved in the total evaluation of the software packages? Year(s) _______ and Month(s) _______

QUESTIONS REGARDING COSTS AND FUNDING:

7. Software Costs: 1-Purchase: $_______ 2- Annual Maintenance:$_________

8. Hardware Costs: 1-Purchase: $_______ 2- Annual Maintenance:$_________

9. What was the total cost of implementation; including hardware, software, consultants, file conversions, etc.? $___________

10. Was this over or under budget? 1 Over 2 Under Percent ___________

11. What percentage of the funds for the acquisition and implementation of the software package came from outside sources? ___________%

12. a) What were the sources of these external funds(please identify all)?

    1-Title III______ 2-Corporate Grant______ 3-Private Grant______

    4-Other Government Grant______ 5-Other-identify ________________

    b) If funds would not have been forthcoming from an outside source, would this specified package have been selected? 1 - Yes 2 - No

    c) Would any package have been selected? 1-Yes 2-No

QUESTIONS REGARDING IMPLEMENTATION AND CURRENT UTILIZATION

13. Elapsed time to get the entire system operational? Years____Months____

14. How many people in computing services were involved in this task?
#______ & number of Full Time Equivalents(FTE) ________________

15. How much systems support(people) was required from the vendor to install all of the modules? Months _______/Cost $___________

16. Did you use on-site vendor training? 1 - Yes 2 - No Cost: $_______

17. Are you contracting with the software vendor or some outside source for continuing applications software support, other than the annual maintenance? 1 - Yes 2 - No Cost/Year $_____________

18. What was the previous mode of providing administrative computing service?
1. In-house software development 2. Service bureau
3. Consortium 4. Regional computing facility
5. Used another software package. Name of package:___________________
6. Manual Systems 7. Other: Specify_______________

19. How did the use of a software system impact the time required to install the college's application system compared to this previous approach?
1 - decreased substantially 3 - increased moderately
2 - decreased moderately 4 - increased substantially 5 -no impact

20. Please identify and rank order the two most important factors that caused problems during implementation:
1. ________________________ 2. ________________________

21. Please identify and rank order the two most successful factors that you experienced during implementation:

1. ________________________ 2. ________________________

QUESTIONS REGARDING USER SATISFACTION AND FUTURE USE

22. What has been the effect of utilizing this package on the following? (Please circle Yes or No for each)
1) Yes No Ad-hoc queries can be handled more quickly.
2) Yes No Applications are installed more quickly.
3) Yes No Data integrity (correctness) has improved.
4) Yes No Eliminates the requirement for in-house programming.
5) Yes No Reduces reliance on in-house programming.
6) Yes No More information available for operational functions.
7) Yes No People adapt quickly to changes in procedures.
8) Yes No The computer staff is more involved in coordination of activities between the operational units of the College.
9) Yes No Significantly more integrated(cross application) information available.
10) Yes No More use of integrated information for management decision making.
11) Yes No Users have more direct control of the system.
12) Yes No Users have more access to information on-line.
13) Other Comments:

23. To what extent would you consider the implementation or use of this package a success or failure at your institution?
1 - a dismal failure 3 - highly successful
2 - somewhat successful 4 - an overwhelming success

24. Do users create their own reports? 1 - Yes 2 - No

25. Do users create their own screens? 1 - Yes 2 - No

26. Did you acquire the source code? 1 - Yes 2 - No COST $________

27. Does the college modify the application software? 1 - Yes 2 - No

28. If yes, who modifies the software? Circle all that apply.
1 User 2 Computer Staff 3 Vendor 4 Other

29. If you were making a decision to develop or install an MIS in the near future, what would be the most likely action?
1) acquire the same software
2) acquire another package
3) develop your own software
4) resort to a manual system
5) use a service bureau
6) participate in a consortium
7) other: please specify

30. Would you recommend the use of this software to another institution that is similar to yours in organization and control?
1 - No 3 - Strong recommendation
2 - Qualified recommendation 4 - Yes, without qualification

31. What is the likelihood that this software will continue to be used at your institution for at least two more years?
1 - no possibility 3 - good possibility
2 - some possibility 4 - virtual certainty

32. What advice do you have for institutions that are evaluating MIS software? In other words, what would you do the same or differently?

33. Please identify the Software Application Modules(subsystems) that were acquired, on the reverse side. Please distinguish between the modules acquired initially and those that were acquired subsequently.

POLICY ISSUES SURROUNDING DECISIONS TO USE MAINFRAME OR MICROS

Phyllis A. Sholtys
Northern Kentucky University
Highland Heights
Kentucky

Since its inception, computing has demonstrated economies of scale - the larger the computer, the lower the unit cost. Now however, much greater price/performance is obtained with a micro than with a mainframe. Although large applications and large data bases still require large computers, some traditional applications are being implemented on microcomputers or in a shared processing environment encompassing both micro and mainframe capability. While this does not signify the end of the mainframe, it does indicate that major changes lie ahead and that a rethinking is in order for how and when each computer is used within the university environment.

This paper discusses the major issues and tensions associated with the the growing reliance on microcomputers as serious business tools. Ideas are discussed concerning organizational adaptation to what is perceived as a fundamental change now occurring within the computer industry.

Background

Since its inception, computing has demonstrated economies of scale - the larger the computer, the lower the unit cost. Now however, with the development of the microcomputer, much greater price/performance is provided by a micro than by a mainframe. "Downsizing" has become the newest catchword to expand our growing computer vocabulary as more and more traditional applications are being implemented on microcomputers or in a cooperative processing environment encompassing both micro and mainframe capability.

A new revolution is beginning in which "the battle cry is smaller, faster, and cheaper."[1] While this revolution does not signify the end of the mainframe, it does indicate that major changes lie ahead and that a rethinking is in order for how and when each computer is used within the university environment.

Computer Economics and Implications

Microcomputer purchases now dominate the market place with more money spent on micros than on any larger class of computers.[2] Another economic fact of life is that today's micros already possess the power of yesterday's mainframes, and microcomputer capabilities continue to improve dramatically. As microcomputer power increases, software development is making corresponding advances in sophistication, ease of use, function, and capacity. Microcomputer software is inexpensive when compared to mainframe packages. Moreover, the programming effort required to develop a system on a microcomputer is much less than that required for mainframe development. For those capabilities available on a microcomputer, users can now be supported for less cost with a micro than by shared access to a mainframe. Thus, in many situations, the potential exists to realize significant savings if micros are utilized.

The earliest use of microcomputers was primarily for individual computing applications such as word processing and spreadsheets and these two categories still account for the majority of all use. However, microcomputers are increasingly used for more complex applications as evidenced by 1) use of micros to automate small organizations and projects that have low priority for or little possibility of mainframe support, 2) downscaling of mainframe software to run on micros, and 3) the introduction of cooperative systems that use both mainframe and micro.

---

[1] Rick Higgens, "Find Out Where Your Networks Are Going - And How To Get There," Information Week, July 7, 1986, p. 22.

[2] Richard Makita, "Satisfying MIS and Users," Computerworld Focus, October 8, 1986, p. 39.

The combination of powerful microcomputer hardware and software has made it both possible and cost effective to automate small organizations or projects. Small businesses and professional offices are rapidly adopting micros to maintain client and other business records, while in higher education microcomputers are supporting functions ranging in diversity from auto registration to career counseling.

In addition to the development of software specifically for micros, the computer industry is experiencing rapid growth in the phenomenon called "downsizing" in which software originally written for larger computers is being rewritten for microcomputers. Two major categories of software are being rewritten for microcomputer use. In the first we find basic tools such as programming languages, system development aids, statistical packages, data base management systems and modeling systems.[3] Downsizing is also prevalent in a second category of software that includes applications such as accounting packages, point of sale (POS) systems, inventory systems, personnel systems, etc.[4] In addition to the migration of vendor-supplied application packages, a growing number of organizations are converting in-house applications from mainframe or minicomputer to run on micros.[5]

Further, a modest but growing trend toward development of cooperative mainframe-micro systems is occurring. A "cooperative system" is one in which both micro and mainframe are utilized as a functional unit. While not full partners in a true distributive processing system, micros are readily used as semi-autonomous data entry workstations, as tools to develop off-line reports, and to provide ad hoc data inquiry. The cooperating mainframe provides data processing, storage and distribution. Software companies are developing commercial packages to support this approach. As one example, the "Goldengate" micro package will analyze, manipulate, and report on data extracted from Cullinet's provide an interface between the mainframe products and popular micro software.[6]

---

[3] Included in this wide array of mainframe and minicomputer software now available for microcomputers are Cobol, MicroCICS, SAS, Focus, Oracle, IFPS/Personal, and numerous other packages.

[4] Jordan Gold, "Move Over Mainframes," Computer Decisions, July 15, 1986, pp. 56-58+. Also see Phillip Good, "Micro Accounting Migrates to Departmental Computing," Software News, October 1986, pp. 55-60.

[5] Rita Shoor, "The New Software Resource," Infosystems, July 1986, p. 70.

The Impact of Microcomputers

What does this all mean to the MIS professional? At the very least, a rapidly changing computing environment. Traditional data processing and large mainframe computers are associated with centralization of computer equipment, centrally controlled systems development and operation, and strong, centralized control of data integrity and access. The typical mainframe environment is one in which a data processing department provides services to users who know little about computers or the systems running on them. The role of the user is largely limited to identifying the kinds of services and reports needed and to providing the flow of data required to maintain data currency. Non-computer personnel tend to view these monolithic computer systems and computer professionals as part of a mysterious, alien world - the black box beyond the comprehension of all but the highly trained professional.

The implementation of microcomputers represents a radical departure from traditional mainframe computing. Microcomputer equipment is located not in central areas, but in users' offices. Office personnel exercise total control over the computers, the software systems running on them, and the data stored in them. Powerful analysis and modeling functions, data bases and sophisticated graphics are all readily available. Offices can obtain information from their systems at their own direction - a heady feeling indeed, for those who previously perceived they were at the mercy of MIS professionals. There is, however, increased responsibility that accompanies the increased freedom and flexibility. For the typical micro used in the office setting, departmental personnel serve as systems analyst, programmer, input clerk, and computer operator. Office personnel design applications, write the code, boot the computer, mount the disks, key the data, tend to the printer, and (hopefully) back up files, a marked contrast to traditional data processing where specialists are responsible for each of these steps.

With active micro use, some of the computer mystique disappears and greater understanding of computer concepts is developed. There is also growing evidence that increased microcomputer use actually promotes use of mainframes, for "...as people get hooked on computing through the use of micros they turn to larger computers for more sophisticated applications. In short, rather than micros stealing part of a fixed computing pie, the new-found enthusiasm prompted by micros helps enlarge the pie."[7]

---

[6] Information Associates and Systems and Computer Technology (SCT) are among the vendors offering these links in conjunction with their higher education application packages.

The microcomputer has won a solid place in American offices and the initial debate about their usefulness is over, or at least in the last stages. Most computing professionals now acknowledge the versatility and power of microcomputers and they are are becoming increasingly concerned about how to best incorporate them within the institutional computing environment. Confusion abounds and a number of policy issues and concerns surrounding the role and use of microcomputers must be addressed.

Policy Issues Related to Mainframe-Micro Decisions

Planning: The most compelling policy issue is the need for planning. In many organizations, the earliest use of micros was ad hoc in nature, and not accompanied by formal planning or coordination of their use. Lack of a coordinated plan and professional support for microcomputing are directly related to most of the major problems experienced with micro use, such as uncontrolled proliferation of equipment and software, data incompatibility, integrity, validity, and security problems. To be truly effective, however, the planning effort must address far more than microcomputers.

The major planning issue is the need for an institutional information systems strategy and architecture that answer the basic question of how information can contribute to the operation of the institution, both in longer term and day-to-day operations. The strategy developed should consist of an overview of the way information is to be collected and made available to the organization while the planned technical architecture should not be machine specific, but remain flexible enough to respond to new and changing demands.

In defining the appropriate role for microcomputers, it is important to remember that few office personnel employ micros for the technology's sake. Rather, micro use has been a response to the urgent need for flexible, rapid access to data to help people do their jobs. An effective information systems architecture will incorporate that flexibility and access into a longer term strategy.

---

[7] J. Victor Baldridge, Janine Woodward Roberts, and Terri A. Weiner, The Campus and the Microcomputer Revolution (New York: The American Council on Education/Macmillan Publishing Company, 1984) p. 34.

A fundamental change occurred in the work place as user-computing became commonplace: **computing has, for all time, outgrown the data processing department.** Industry-wide, the move to decentralized information resources is one that will continue. According to predictions, by 1990 sixty to ninety percent of all computing will be end-user based.[8] In an information-based society, it is no longer feasible to attempt to locate all data and processing power on a single, central machine. The planning challenge, then, is to accommodate these changes in a meaningful structure that can meet office needs and still protect the integrity, consistency, and safety of institutional data.

Coordination and Standards: Formal coordination of microcomputer acquisition and use is an essential step in developing a successful information systems architecture. Hardware and software standards must evolve to establish reasonable limits on the diversity of hardware and software to be supported and to insure that they are compatible with the broader institutional information systems architecture. For standards to be accepted and maintained, there must be a formal policy structure supported by top management, implemented and enforced through the purchasing process, and reinforced by the continued availability of training, hotline and consulting support for the users of standard hardware and software. Hardware and software support services may be provided through the user services branch of the computer center or provided by a separate information center organization. However it may be organized, the unit should be dedicated to assisting office personnel in using computer resources to their maximum advantage. The availability of user-computing support services is one of the most effective means for obtaining willing compliance with institutional micro standards.

Hardware, Software and Data Security; Data Integrity: The MIS profession has spent many years developing disciplined methods to maintain hardware and software security, verify data and insure ongoing backup. Novice micro users are often unaware of the critical importance of these steps until problems are encountered. As a result, there is growing concern about the validity, integrity, and security of microcomputer-generated data. There are also additional security concerns related to the small size and transportability of hardware, software, and data files, and the relatively accessible office environment in which they are located. All of these problems are becoming of increasing importance as the use of micros escalates. Microcomputer use policies must address issues of how data and programs are to be verified and protected, what institutional data will be available for end-user computing, and the legal responsibilities associated with end-user computing.

---

[8] Naomi Karten, "Reshaping the Info Center," Computerworld Focus, October 8, 1986, p. 37.

Successful implementation of these policies depends upon effective communication with users about the purpose for the policies and the benefits provided. A support program to instruct office personnel in appropriate procedures for the use of microcomputers is also essential. Just as information center support helps insure adoption of hardware and software standards, the same support mechanism has been shown to be an effective means of preventing and eliminating data problems associated with microcomputer use. Data integrity problems often decrease dramatically when micro users are provided with controlled access to official institutional data maintained on the mainframe. Mainframe computer systems represent central data banks which are capable of providing consistent, valid and unambiguous data to meet office needs, while the micro can be the vehicle to provide access to and flexibility in using that data.

Development responsibilities: If computer professionals develop a cooperative micro-mainframe system, the micro component will most probably be completed by professional programmers and will adhere to established development standards. Development responsibilities for other approaches are not as clear cut and responsibilities for user-computing activities are in urgent need of clarification.

Any micro user with access to appropriate software can become an application developer. In many organizations there is a tendency for MIS to ignore all systems developed outside the traditional development shop or to write off user-developed applications as inefficient and lacking in technical sophistication. However, if programs and systems developed by users are meeting defined needs, they represent an organizational asset which should be identified and protected. A major risk associated with user-developed systems is that many lack documentation and training materials needed for others to continue operation of the system after the original developer leaves the organization. Appropriate training and assistance for user-developers can help prevent this problem, as will communicating to department heads about the difficulties that result from lack of documentation. The services of an internal auditor can also provide an excellent incentive to insure that development standards are maintained by offices that create their own systems.

The need for complex microcomputer systems presents an institutional dilemma. Microcomputing is synonymous with user-computing; but, complex applications may be beyond the expertise of the "office programmer." Although guidelines should be available to define the types of systems that are appropriate for microcomputer development by end users, there can be no hard and fast rules or rigid enforcement mechanism to guarantee compliance. In the final analysis, if busy departmental personnel are willing to develop an application with their own resources, it is strong evidence that a valid need exists. Moreover, there is no effective way to inhibit a project, short of providing a professionally-developed alternative.

Professional development of microcomputer applications is an issue that will ultimately arise in every organization when creative ideas exceed the technical capabilities of office staff. Organizational responses to this need vary greatly. Some institutions provide consulting time and professional project guidance to user-developers who need additional assistance with complex projects. Some information centers are beginning to do application development for users. However, this path represents a significant departure from the basic mission of information centers, which is to assist users, not to "do it for them." Finally, some development shops are beginning to include microcomputer applications as as expansion to their ongoing development activity. Microcomputing is still so new that there are no ready solutions. Each institution must weigh the various options and make its decision based upon perceived costs, risks, and benefits.

Communication Networks: Communication networks are the pathways to a successful information systems architecture. Much thought should be given to development of an appropriate network strategy to meet institutional needs. A major issue to be resolved for each organization is whether network development efforts should emphasize mainframe-micro communication or if greater benefits could be realized through implementation of micro-to-micro communication networks.

The prospect of microcomputer-based distributed processing networks is attractive to many, particularly middle managers who are protective of the newly-won autonomy associated with microcomputer use. A commonly held belief is that since micros provide freedom from MIS domination, microcomputer networks will provide even greater flexibility and freedom of access. At the present time, however, the available micro-to-micro networks are relatively unsophisticated and "...a true distributive processing system is expensive to design and tricky to implement, and precious few tools designed to ease this burden are available."[9] Most present micro-based networks cluster a group of micros in a setting where one acts like a mainframe by serving as host for the others. Available network software lacks sophistication and there are few advanced application packages designed for this multi-user environment. Once technical difficulties are overcome, however, large scale data storage and management functions can be moved from a mainframe host to a micro-based network. This approach transfers all of the management, maintenance and operating responsibilities now associated with mainframes to a different medium - the network. The resulting network requires the expertise of a professional organization to provide development support and ongoing operation. It is no more a user-operated undertaking than is the present mainframe shop.

At least for the foreseeable future, the limitations presently associated with security and data handling on a micro-based network will assure a continued role for the mainframe as the host for institutional data. Current mainframe-micro links already provide a number of capabilities: Micros can be used as collectors and editors for transaction data which is passed to a mainframe host for inclusion in an institutional data base; the means are available to extract and download mainframe data to the micro for off-line analysis and report processing; micros can be easily provided with the terminal emulation capabilities needed to support mainframe access and user-computing; and there are a number of software options available which use the mainframe host as a "post office" to collect and forward messages and data files from one micro to another.

By using mainframe-micro networks, users achieve the economy, flexibility and rapid access of microprocessing, combined with a conduit to mainframe data resources and the backup, security and power of the mainframe center. Thus, it appears that, barring unforeseen price and performance improvements in micro networks, the marriage of mainframe and micro technology holds the greater promise for the future.

People Issues: Although micros quickly evolved from hobbyists' toys to serious business tools, many mainframe managers and programmers have been reluctant to acknowledge their usefulness. With the rapid infusion of micros into the office setting, MIS felt threatened by a perceived loss of prestige and control and by competition for resources. The traditional role of keeper of the standards was undermined by the autonomy of microcomputer users. When it became apparent that micros could no longer be ignored, MIS took on the task of organizing them with the goals of reducing data chaos and integrating micros into the institutional information architecture. Even though MIS is now largely in control of the selection and implementation of micros, there is still reluctance on the part of some professionals to pioneer new approaches that can fully utilize micros' capabilities. Perhaps this is because of the old data processing adage that "Pioneers get arrows in their backs," or it may be reluctance to advance the cause of the upstart computer that launched a rebellion. However, it is important that any grievances be forgotten and that MIS build to the future, using each available technology to its greatest advantage.

---

[9] Michael K. Guttman, "Untangling Network Software Tie-Ups," Computerworld Focus, July 9, 1986, p. 26.

Because micro users frequently develop a sense of ownership for their systems, office staff may resent the intrusion of standards, rules and mandated procedures. At best, controls will be viewed as a necessary evil. Thus, it is up to MIS to provide clear communication with office personnel so they will develop an understanding of the need for standards and the benefits provided to the office by their adoption. It is important that MIS be perceived by end users as a partner in helping them make effective use of their microcomputers.

It is also important to keep top management apprised of newer developments associated with the evolution of the computer industry. Information technology is moving rapidly, many long-established concepts are being challenged, and it is important that decision-makers be kept aware of the changes and their potential for the institution.

A major responsibility for MIS leadership is the need to address the human issues both within the MIS unit and the broader organization. During times of rapid change, continuing open communication with all areas and levels of the organization is absolutely essential.

Future of Mainframe Computing Centers

What type of data processing will ultimately prevail? It is most likely that both big and little computers will continue to be needed and used. Small systems and simple applications will be built and maintained by users, and user-computing will dominate the analysis and reporting arena. Institutional data base systems will continue to be developed and maintained by computer professionals who will use large computers to process and store the large data bases involved. Micros will be tied to mainframes by high speed communication networks, thus providing users with the benefits of both worlds.

The mainframe computer center will continue to play an essential role in this scenario. A high level of professional expertise is essential for building large, complex, transaction-oriented data base systems and for designing and coordinating cooperative mainframe-micro systems. However, mainframe shops are due for major changes as their role and responsibilities become more demanding. They will evolve into organizational data centers and data distributors. Much time will be spent on developing and implementing communication networks, on perfecting methods to provide a seamless integration of micros and mainframes, and on developing methods to assist users who will do much of their own computing. Distribution of data, presently achieved via printed report or CRT, will be extended to include distribution to a micro. With the implementation of powerful mainframe-micro networks, mainframe centers also become logical designees to provide backup and security for critical micro data files. Thus, the demands made of MIS professionals will increase in scope and complexity.

In preparing for the future, professional staff must develop additional expertise in data communications, for the ultimate resolution of mainframe versus micro issues will depend on powerful communication networks. The network is becoming the backbone of the modern information system and will be the ultimate determinant of overall system performance.

Mainframes and micros have different strengths and both are needed by the modern organization. The challenge to MIS is to develop an information systems strategy and architecture that can utilize available technology to the greatest advantage. The planning imperative is to develop the appropriate integration scheme.

ALTERNATIVE MODELS FOR THE DELIVERY OF COMPUTING AND COMMUNICATIONS SERVICES

E. MICHAEL STAMAN

Introduction

The "fields of force" which affect university computing and information processing executives have evolved significantly from those of thirty years ago, when the key issues were capability, capacity, and compatibility. Examples include such previously non-traditional activities as supporting information centers, deciding when and how to use "productivity tools", dealing with purchasing rather than building new services, and providing leadership in the overall area of integrating college- and university-wide systems into one cohesive service.

While computing executives, who are frequently becoming known as "Chief Information Officers (CIO's)", still have clear responsibility for central computing services, the nature of those services today is simply not the same as in years past. Their role as a provider of traditional computing systems and services has been expanded to include activities ranging from network planning and management to acting as consultants to what is becoming a largely self-directed community of users. The priorities (Figure 1) are almost the inverse of those of ten, or even five years ago, with the role of "systems integrators" rapidly evolving as the top priority.

The purpose of this paper is to explore various tools and models for providing computing services which have evolved as a result of changing technologies and user abilities. The questions that the paper seeks to explore are:

- What were the key ingredients of each model or tool at the time of its evolution?

SHIFTING PRIORITIES

NATURE OF CENTRAL SERVICES IN THE FUTURE --

Integrator of a Diverse Set of Systems, Networks and Hardware

"Information Center" and Caretakers of Data/ Information Resources

Network Planning & Management

Provide Standards, Procedures

Consultants, Advisors to a Largely Self-Directed Community of Users

Set Up New, Specilized Services

Operator, Provider, Developer of Traditional Systems and Computing Services

FIGURE 1

- How and where does each model or tool fit into spectrum of approaches to providing computing and communications services today?
- What is the nature of the new systems integration imperative?

The paper begins with a review of the original model, "computing classic", and will consider tools and models such as distributed computing, fourth generation languages, information centers, and the use of the computing services industry, including "buy versus build" decisions. The conclusions should not come as a surprise to many -- all of the models fit, and the systems integration problems of today include all of the leadership and management problems which have evolved through the past thirty years. Capability, capacity, and compatibility are still issues, but the key issue turns out to be how to best fit the range of alternatives available into the solutions required by universities today.

Computing Classic

Older is not always better. An IBM 704, for example, cost about $2 million, had 32,000 words of memory, and cost $800 per month to power and cool. The mean time between failure was several days. Migrating through a seemingly endless number of new architectures was, at best, a labyrinthine and uncertain adventure.

The organizational structure was clearly centrally managed; operations, systems development, and all other services were provided from a pool of central resources. Development models were batch oriented, without data bases as we know them today, and with all of the problems associated with turnaround documents, centralized data entry, and difficult ad hoc reporting requirements. Providing support for modules of what should have been a system, but was really a sequence of programs designed by different people at different points in time, with different architectures and duplicate data structures was an extremely difficult, if not impossible task.

Capability, capacity and compatibility problems were the key issues. Users, and to some extent, data center executives, were not sure what was possible through the use of an "Electronic Data Processing (EDP)" facility and, almost invariably, needs quickly exceeded storage capacity, memory capacity, and processor capacity. Nothing seemed compatible with anything else.

The classic model served well for many years, and, in context, is still an important alternative. Today, the model does not really exist in its purest form, since by definition the acquisition of even one microcomputer to perform processing at any non-central location begins the process, and problems, of distributing computing. Many of the original problems with this model have been solved through database architectures and on-line systems.

Universities should not, in fact will not be able to attempt to do without this alternative. If the alternative exists for no other purpose, central facilities will continue to be required to support university owned data bases and to continue to support targeted operations which cannot cost effectively support their own requirements for information processing. The term "computing begets computing" clearly applies -- the evolution of microcomputing and distributed computing has caused greater sophistication on the part of the user community, and as a natural consequence, greater pressure on central facilities.

Distributed Functions

At first, the problems involved whether to distribute. The issues were whether computing executives could maintain control, synchronization of data bases, and compatibility. Capacity was much less at question, since one could conceivably continue to expand the distributed architecture to meet processing needs, but capability was an issue since no one seemed to know how to build distributed applications.

Today, the problem is what to distribute. Consider the following factors:

- Interactive versus batch needs
- Capacity of existing machine resources
- Communications costs
- Requirements for availability of services
- Price/performance analysis
- Horizontal versus vertical organization

There is no stock answer. The factors above affect that extent to which one can distribute the functions which form the core of central activities.

Certain aspects of technical operations, for example, are more easily distributed than others. The questions are where to put hardware operations, communications support, systems programming, production control, and each of the other aspects of the function. Similar questions exist for applications development (data base administration, applications programming, systems analysis, systems documentation, user training, etc.), and control (security, setting priorities, standardizing tasks, personnel planning, evaluating products, etc.). While one might be willing to distribute scheduling under a complex, horizontal organizational structure, for example, one might not be quite so willing to distribute planning and budgeting under the same structure.

Distributing functions can be an extremely effective alternative. Organizationally it makes sense because data entry, data integrity, and to some extent, the accuracy of reports can be assigned to units with the greatest vested interest in the quality of their information. Admission offices, for example, care a great deal about socio/demographic data; business offices do not.

Similar arguments exist in support of the distributed alternative as an effective agent for: computing planning and budgeting purposes (controllable upgrades), solving access and processor capacity problems, and dealing with some of the political forces which often affect centralized facilities.

The alternative will fit into the spectrum of solutions even better in the future. Technological compatibility will always be a problem, but the issue is so well understood today that the problem has become routine. Declining costs for technology will permit universities to distribute increasing amounts of machine intelligence, and the real compatibility problems that will evolve relate to the impact of distributing data, and consequently of seemingly incompatible reports generated by different offices from the same data base.

Productivity Tools

The term "automatic programming" has become roughly equated to "applications development without conventional programming". Vendors will claim that programmers, who normally average 10 to 20 lines of code per day, can increase productivity to 1,000 lines per day. Buyers might conclude that a one-hundred fold increase in productivity is possible, and that one ought to be able to produce new applications systems at least several times faster with productivity tools than without. The tools have been divided into classes: non-procedural languages, report generators, query facilities, functional application products, and fourth generation languages. Each has a different purpose.

But conventional programming has traditionally involved many specific steps: user definitions, design, development, pre-implementation, implementation. Each step results in specific deliverables -- a technical product, user manuals, and operations documentation during the development step, and the act of coding is but one part of the applications development process.

Figure 2 depicts one version of the process. Prototyping helps, but the majority of the effort, from conception through operation, is not coding intensive. Doing the job right involves paying as much attention to user

THE SYSTEMS DEVELOPMENT PROCESS

- Many Specific Steps -

Step	Results In
User Definitions	Functional Specifications Budget Estimates
Design	Technical Specifications Documentation Better Budget Estimates
Development	Technical Product User Manuals Operations Documentation
Pre-Implementation	User Testing User Training
Implementation	Turnover Production Monitoring Operations

FIGURE 2

training as to coding modules to update the data base. Equally important are questions such as efficiencies of machine use, response time, maintenance, and post implementation modifications. Expectations need to be managed during the acquisition process.

A Chief Information Officer would select productivity tools and one of the delivery agents for a great variety of reasons. First, and perhaps most important, significant productivity gains can be obtained during certain parts of most applications. Screen generation, as one example, is easier and faster with appropriate productivity tools. End user computing, discussed in more detail in the section on "Information Centers", would not be possible to the extent that it is today without report generators, statistical packages, and query facilities. Finally, activities such as centrally supported ad hoc reporting, and some aspects of batch reporting can be performed with significant increases in productivity, assuming that the correct tools have been chosen.

Information Centers

Information centers have evolved as natural consequences of both the distributed function and the productivity tools alternatives. Universities are clearly dealing with an expanded applications development environment, one in which programming is performed in at least three levels: traditional data center employees, information specialists (e.g., budget analysts, institutional researchers), and a host of other, typically less sophisticated end users.

End users, however, are rapidly becoming more literate in computing because of the increased availability of microcomputers and are, therefore, becoming more involved in computing activities. This trend, coupled with the trend toward increased use of selected productivity tools by end users has significantly changed the environment in which computing and communications services are provided.

The alternative that CIO's have is to either establish, or support, an information center, or to accomplish the same goals by appropriately increasing the resources allocated to user services within the existing data center. Such centers serve to become a focus for training and consulting for end users, similar to a traditional academic computing center.

Information centers also can, and perhaps should, be used as agents to reduce applications backlogs. One important factor in the amount of resource available to develop and maintain new core applications is the requirement for ad hoc programming. Too much ad hoc requirement in the backlog generates problems such as:

- Slow responses to requests
- Delays in new systems development
- Unhappy users

Using an information center to reduce an application's backlog involves developing policies which would cause, whenever possible, initiators of ad hoc requests to learn how to develop their own reports. The argument in favor of such an approach is that centrally funded and managed resources are scarce and expensive, and may be best allocated in support of new systems implementation. It is not clear that universities will continue to be able to afford the luxury of a pool of individuals allocated specifically to responding to ad hoc requests.

Whether information centers will continue to exist in their present form is not clear, although it is probable that they will. Of greater clarity is that end user computing will continue to expand as costs for technology continue to decline, uses of technology become less difficult and end users of technology become increasingly more sophisticated. As an alternative for providing services, use of information centers or their derivatives will become among the options selected with increasing frequency.

Computing Services Industry

The computing services industry began in the mid 1960's and has been growing at the rate of 20% per year for the past decade. It exists in part because of the relative newness of the entire computing industry, in part because of needs for additional expertise on an "on-demand" basis, and in part because of the ability of any industry which has made significant capital investments in people and products to leverage those investments in cost-effective ways.

The industry offers a range of alternatives to a CIO trying to develop the most cost-effective solution to the problems at his or her university.

Products and services available include:

- Consulting
- Contract Programming
- Data Processing Services
- Applications Software
- Facilities Management
- Systems Integration Services

A CIO's decision to turn to a vendor for a particular solution will almost always be based either on the availability of in-house expertise or cost, or some combination of the two. For example, the trend toward purchasing large, complex, packaged applications software rather than build, is based on cost ratios ranging from 10 to 1 up to 100 to 1, and on time savings of up to 10 to 1. On the other hand, a decision to buy custom software is much more difficult to make because it is not nearly so clear whether there will be significant cost savings, even in light of potential time savings and possible lack of in-house expertise.

The computing service industry has evolved along with the remainder of the industry. Increasingly, vendors offer relational data base products, products which support upload and download capabilities, and products or systems which are fully integrated into their overall product line. Vendors are increasingly interested in trends in systems integration, integrated workstations and mission critical systems, and, to some extent, products and services are being offered in these arenas.

Universities have traditionally not adopted products from the computing services industry as rapidly as their counterparts in the private sector.

Need was perhaps an inhibitor, cost another, and pride of in-house developed solutions a third. Trends are reversing each of these inhibitors. As university executives become increasingly sophisticated in their applications of technology, and as those applications become increasingly complex, the tendency to depend totally on in-house solutions will probably become less. Finally, as vendors continue to pour capital into the development of a spectrum of integrated products and services, the ability to compete cost effectively for some of those solutions with in-house alternatives will also probably diminish.

The Systems Integration Solution

Systems Integration is the term being used by most CIO's for the alternative that they are constructing to solve today's computing problems. Viewed as separate entities in the past, things like distributed computing, communications, information centers, purchasing software or services, multiple vendor hardware environments, and all of the other elements that comprise the information resources environment of today's universities are now viewed as all pieces of a single puzzle. Capacity, capability, and compatibility remain as key issues, but the questions are now focused at the component level rather than at the systems level. Integration of these components into one cohesive service is, and will be, the central problem of the next decade. From the chair of the CIO, it does not make sense to have the typical array of capacities and machine intelligence, from micros to mainframes and from copiers to facsimile devices, spread throughout the university without having some way to have all of that intelligence talk to itself. One way to clearly increase the return on the investment that a university has made in technology is to recognize that the integrated sum of that investment is significantly greater than the accumulation of its elements.

Thirty years ago the "computing center" was a single entity in a discrete physical location. We now need to think of our "computing center" as the university, with bits and pieces of the center's machine intelligence spread throughout the university and linked together with a communications network. Communications becomes the integrator; information centers and things like productivity tools become catalysts that distribute.

Summary

The matrix in Figure 3 contains examples of the needs which typically face CIO's today. Across the top of the matrix are the alternative models and tools discussed in this paper. What one must conclude from this matrix is that neither the needs nor the alternatives form mutually exclusive subsets. Hence the need for a systems integrated oriented solution.

Good management dictates that one attempt to obtain the best possible return on investment, whatever its level. Alternative models for the delivery of computing and communications exist as never before, and it is becoming increasingly incumbent upon CIO's to optimize through finding the "best fit" between University needs, available resources, and available options for the allocation of those resources.

ALTERNATIVE APPROACHES FOR SERVICES

MODELS AND TOOLS / EXAMPLES OF NEEDS	Classic Model	Distributed Functions	Productivity Tools	Information Centers	Computing Services Industry	Systems Integration Model
Develop and Manage University Data Bases	X				X	X
Support Ad Hoc Programming	X	X	X	X		X
Connect Diverse/Distributed Machine Intelligence					X	X
Control Operations, Development, Policy, etc.	X	X				X
Manage Expansion/Upgrade Cost Increments		X				X
Develop and Maintain Core Administrative Systems	X				X	X
Assign Responsibility for Data Integrity/ Ownership	X	X				X
Implement Large Scale Systems	X				X	X
Conduct Large Scale Projects	X				X	X
Support End-User Computing		X	X	X		X
Support Non-Traditional Applications E-Mail Communicating Copiers Office Systems Etc.		X		X		X
Reduce the Applications Backlog		X	X	X	X	X
Train and Consult Users	X			X		X

Figure 3

CONVERGING TECHNOLOGIES REQUIRE FLEXIBLE ORGANIZATIONS

Carole A. Barone
Vice President for Information Systems and Computing
Syracuse University
Syracuse, New York

The creation of the position of so-called computer czar is only the first step in an institution's coming to terms with the rapid change in computing technology, the changing academic and administrative demands on the computing organizaton, and the convergence of voice, data, and video communications. Traditional administrative processes and structures hamper the flexibility that is essential for the institution to flourish in such an environment. Syracuse University has developed a planning process, implemented an organizational design, and adopted a managerial philosophy to permit the optimum use of available resources, while at the same time achieving its goal of creating a computing environment that strengthens the University's instructional and research programs and provides sophisticated administrative support systems.

CONVERGING TECHNOLOGIES REQUIRE FLEXIBLE ORGANIZATIONS

As the computing environment on college campuses proceeds to change at a relentless pace, academic institutions search for ways to control the impact. Those charged with leading the institution toward the achievement of its educational and administrative goals strive to convince themselves and the community that the progression is somewhat orderly. Computing plans, the merging of technologies and of the organizations that manage them, the rush to upgrade hardware, and the scramble to install and network microcomputers are common reflections of an institution's attempts to cope with the current computing convulsion. The rate of change in the technological environment is so rapid and chaotic that one no longer speaks of the evolution of computing. Nor does revolution connote an accurate image of the current turmoil; convulsion is a more accurately descriptive term.

Coping with the Convulsion: Policy Issues

Administrators today are constantly challenged by the policy issues associated with the computing convulsion. Their policy concerns include: providing adequate access to computing and adequate support services, addressing the tension between the requirements of the instructional and the research users, clarifying user expectations and defining the respective responsibilities of the users and providers of computing, planning and advisory structures, and alleviating the need to make ad hoc decisions under pressure from the many lobbying factions that form around perceived needs. Administrators must grapple with these policy issues in the midst of a dramatic upheaval in the environment.

The convergence of voice, data, and video technologies, the growing importance of the communications network, user demands for online access to administrative data bases, user demands for the tools to manipulate extracts from centrally maintained data bases, the increased use of online data bases in conducting scholarly research, the advent of video based instruction, the interest of local industry in having access to academic resources through teleconferencing, data transmission, and document delivery services, are a few examples of the emerging technological environment and the concomitant expectations of the community. Even the composition of the community, with which we who have spent our professional careers in higher education interact, has begun to change as the state and federal governments, as well as the industries themselves, encourage greater communication and cooperation between the academic and industrial sectors.

Coupled with this convulsive computing environment is the reality that virtually all academic institutions work with limited resources. These conditions demand creative management from those of us who hold leadership positions at the middle and upper levels. Traditional administrative processes and structures hamper the flexibility that is essential for the institution to flourish in such an environment. The classic bureaucratic design with its rigid chain of command and lines of communication supports a static organization and perpetuates the past. We need to design organizations that are prepared to plunge into the future. This is the challenge of our positions. It is also the reward. The risk inherent in such creativity is invigorating. Those who will lead their institutions to the next tier of computing excellence need to have a vision of a future environment and the guts to step over the precipice to reach it.

It has become a banality that change is the steady state in computing. Unfortunately, traditional computing organizations are structured and populated in ways that resist change and indeed are often muddled and strangled by it. As you know, the currently recommended means to project an academic institution's computing future is a plan. A broadly representative group is charged by the chief executive officer to produce a plan that will guide the institution's effort to shape its computing environment.[1] Such a planning exercise is as much a political process as it is a planning procedure. Moreover, it is not the plan but the planning process that is vital in these convulsive times. A good planning process is ongoing and includes periodic review, revision, and update, requiring associated adjustments in the computing organization.

However, the credibility of the administration, and more specifically of the computing organization, is frequently damaged when the plan is only partially implemented, or perhaps even ignored, because the organization charged with its execution is not designed to include change as part of its organizational culture. Even when sufficient funds exist to support the enormous expenditures required to provide adequate access to appropriate hardware, computing power, and support services, academic institutions will not be able to evade the need for far more fundamental changes in organizational structures and management philosophies.

---

[1] "Report of the Academic Computing Planning Committee." Syracuse University, May 1986, p.2.

Scarce Resources Demand Creative Management

In order to furnish the new and improved services recommended or implied in most plans within existing budgets, the computing organization must reorder priorities, change areas of emphasis, and shift its focus. Since organizational change is constant, the staff must be conditioned to embrace change as a positive aspect of the organizational climate. The use of innovative organizational structures helps to produce the desired fluidity and often results in increased vitality and improved morale. One is stimulated by being a part of an energetic organization, an organization that is constantly sensing and probing its environment and creating opportunities to improve the institution's computing milieu.

The Information Systems and Computing Division of Syracuse University will serve as an example of such an organizational design. However, it is not represented here as the only solution. Organizational designs and structures, like computing plans, like the mixture of computing equipment on a campus, depend on the culture of that institution, which should also determine the strategy followed to achieve the institution's goals. It is futile to try to impose one institution's structure on another. However, many of the same forces are acting upon institutions and aspects of one design may certainly be appropriate elsewhere. Similarly, although there is no one perfect formula for organizational design, fluidity is certainly an essential component in the current environment. The Information Systems and Computing division of Syracuse University incorporates in its organizational design elements of what management theorists term the matrix, project, and team structures as part of a contingency approach to organizational design and management. The adoption of such an approach is a policy decision because it commits the organization at the most fundamental level to the undiverted pursuit of the institution's articulated goals for computing.

After a year long planning process Syracuse University's Academic Computing Planning Committee strongly recommended that the University move vigorously to provide academic users with vastly improved access and support services, including an ubiquitous network, establish a faculty computing education program, recognize the convergence of new information technologies and the emergence in the libraries of an access and service orientation, and offer strong support for office automation and microcomputer users. The planning committee further charged the University to address the inherent tension between the often conflicting requirements of research and instructional users.[2] Some of the planning committee's objectives could be met by changes in policy, for example, and we quickly implemented changes in the acquisition and divestment cycles, and became more aggressive in exploiting conditions in the computing equipment market place, such as vendor discounts, opportunities to divest equipment early in its life cycle, and opportunities for outside funding. We also acknowledged that we could not realistically expect to provide on campus all of the powerful computing resources that our faculty would need to tackle the large and complex research problems of the future. Consequently, we have become active participants in efforts to create regional networks, such as NYSERNet, Inc., and we have recently accepted Cornell's invitation to become a "Smart Node" to their Theory Center. To support this policy decision, the newly created Research Services unit in Academic Computing has established programs to introduce researchers to supercomputing and to encourage and help them to take advantage of the computing power available at off campus locations.

To achieve the planning committee's access and support goals, however, required a major shift in emphasis that could only be accomplished by creating organizational structures that fit the dynamic technological environment. The resulting design had to reflect the University's recognition that a rich, robust, and varied computing environment was essential to its academic vitality and to the goal of creating a computing environment that strengthened its instructional programs[3] and enhanced administrative efficiency. This institutional policy is reflected in organizational design at all levels of the University's hierarchy:

1. the appointment of a senior level administrator to provide strong and highly visible leadership for both academic and administrative computing and related functions

2. the merging of responsibility for academic and administrative computing and the voice, data, and video networks, i.e., network planning and design, inside and outside wiring, protocols, gateways to off-campus networks, under the senior information officer

3. the merging of responsibility for computing services and network systems, i.e., hardware acquisition, operations, systems programming, and networks, for both academic and administrative computing under a single, senior individual within the new organization the Executive Director of Computing and Network Services.

---

[2] Ibid., p.4.
[3] Ibid., p.5.

4. the acknowledgement that managerial responsibility for voice and video communications, i.e., installation of telephones, billing, maintenance of the data base, and video production, should continue to reside in the units to which they were originally assigned. The rationale for the separation of functional responsibilities is to avoid burdening the computing organization with the delivery of the traditional labor intensive video and telephone services

5. the reorganization of the academic computing services organization to emphasize the provision of access and support services to faculty, students and administrators, such as a

Microcomputer Resource Center
Faculty Education Program
Research Consulting Service
Research Computing Unit
Indepth Consulting
Instructional Support Services

6. the encouragement of a close working relationship between and among the three computing service units: academic, administrative, and computing and network services, by housing in each unit functional and administrative responsibility for providing a set of services that support the work of the other units and/or that require the effort of a project group composed of members from the other units. Under this matrix approach to management the assistant directors charged with furnishing these services are responsible both to the director to whom the functional area reports and to the directors of the areas for which the service is being rendered.

The examples that follow illustrate the use of the matrix approach for the delivery of services. Administrative Information Systems supplies security and standards support to all three computing organizations. While Academic Computing Services provides office automation and microcomputing support to both academic and administrative users. Whenever there is an interface between a micro based system and one of the many online applications residing on the administrative mainframe, academic and administratve computing staff members form implementation teams to provide the user with the tools to use both systems to their best advantage. A similar team mix arrangement prevails on projects managed by the facilities managements unit of academic computing. Often the construction of a cluster or the installation of an office support system requires a cooperative team approach involving staff members from Computing and Network Services, Academic, and Administrative Computing, thus drawing on the strengths and perspectives of staff members from all three computing units.

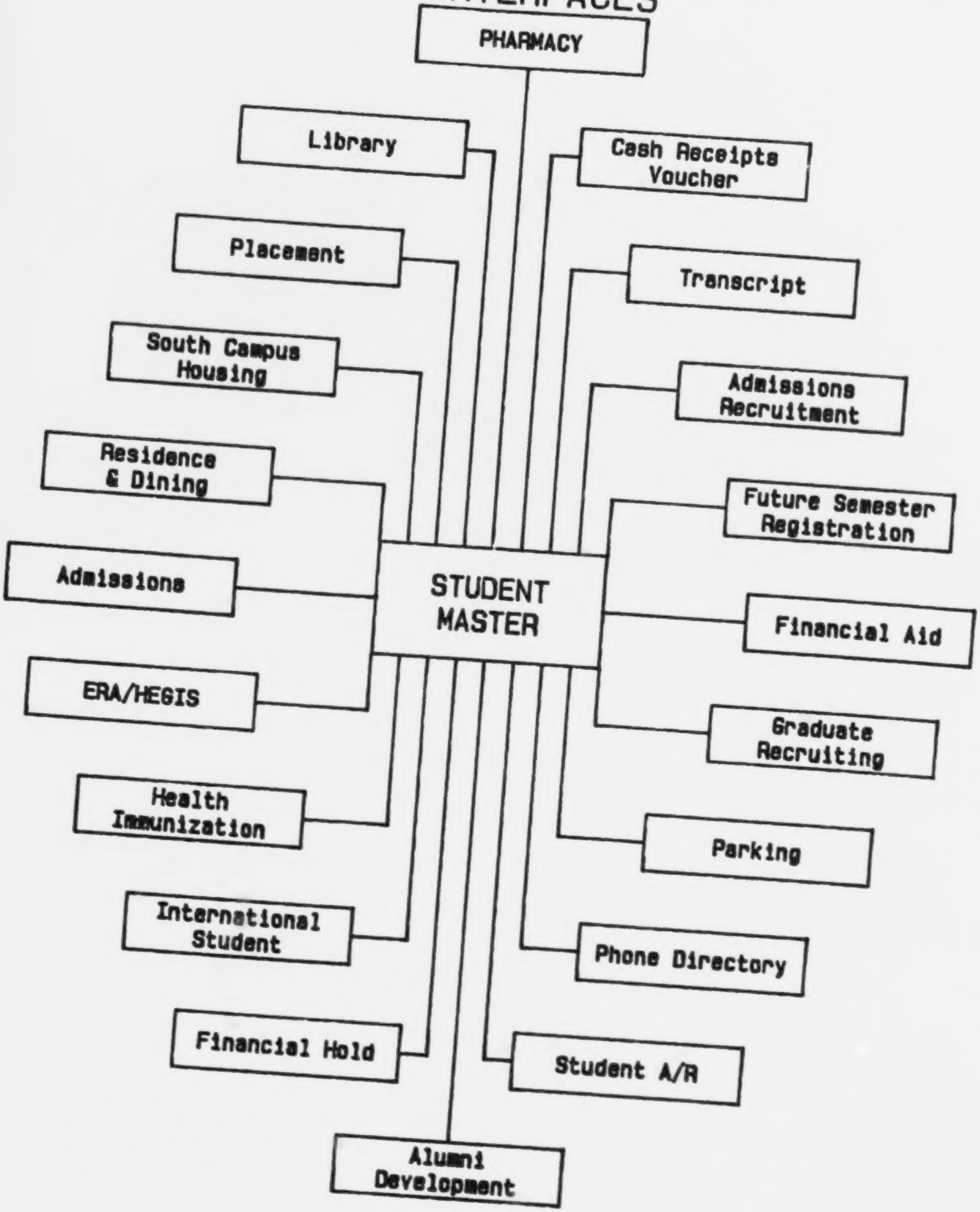
These arrangements support a policy position to squeeze the most out of financial and personnel resources by combining budgets and staffs to provide all users with higher quality service and equipment and more of it. In contrast to traditional structures that support a static environment, these structures, using a contingency design, permit the targeting of resources more effectively, the elimination of overlap and duplication and the strengthening of weak areas. Furthermore, these structures encourage a blending of organizational units, and the crossing of organizational barriers; they emphasize the achievement of specific goals, and recognize the rapid change in the environment. This design also fosters a stimulating professional climate and a host of career advancement opportunities because individuals work with such a broad range of technology and services. The staff has adapted to the changing state and has indeed incorporated change into their own planning. For example, reports of accomplishments routinely address the next set of changes that will need to occur as a result of the current set of activities...a remarkable shift, in a remarkablly short period of time, from the siege mentality of an organization beseiged by demands it felt it could not meet without adding the resources its members knew were unavailable.

The blurring of organizational parameters implicit in this approach has the subtle effect of spreading some of the strengths of Syracuse University's very sophisticated and efficiently managed administrative systems and hardware to benefit the academic computing environment. Figure I shows the data base interrelationships of the numerous online systems that use student data. Syracuse University has implemented 49 administrative online systems since 1975. Because virtually all of our administrative systems are already online, the Administrative Information Systems unit has turned its attention to the development of an information management strategy that includes providing the users at distributed sites with the tools to manipulate data stored and maintained on the mainframe.

Since the publication of the initial plan, the three computing directors responsible for the achievement of its goals have formed working and advisory groups to develop strategies to implement the recommendations, to monitor progress of the implementation process, and to revise and update the plan as goals are achieved. The existence of at least ten different advisory councils and groups ensures that the planning process continues to involve broad representation from the University community and fosters a sense of participatory administration which is beneficial under the stress of rapid change.

FIGURE 1

SYSTEM INTERFACES


PHARMACY
Library
Cash Receipts Voucher
Placement
Transcript
South Campus Housing
Admissions Recruitment
Residence & Dining
Future Semester Registration
Admissions
STUDENT MASTER
Financial Aid
ERA/HEGIS
Graduate Recruiting
Health Immunization
Parking
International Student
Phone Directory
Financial Hold
Student A/R
Alumni Development

The policy decision to encourage the formation of project teams and to use a contingency approach to organization design has fostered a far broader understanding of and appreciation for the academic and administrative goals of the University, and even a richer, more robust, and secure mixture of hardware, software, and systems for the University. Syracuse University is fortunate in having directors and professional staff in its computing divisions who have the ability to work effectively and sensitively in a computing environment where organizational barriers frequently move.

The contingency design does, however, present a leadership challenge in order to avoid confusion regarding responsibilities, turf battles, buck passing, and other dysfunctional behaviors. Cooperation and communication are essential. Indeed such designs need leaders with secure and generous personalities, leaders who attend to their organizations rather than observe them from above, and leaders with the ability to share power and the credit for success or failure. Nontraditional organizations need nontraditional leadership.

A Focus on Self Reliance

The contingency approach applies to programs and policies as well as to organizational design. If computing is to become a pervasive component of the academic and administrative fabric of the institution, and it must, then programs that encourage individual and departmental self reliance are indispensable. Instead of adding resources exclusively to provide central services, Syracuse University targets some resources to support programs that produce an infrastructure of knowledgeable and capable academic and administrative users. Such programs have a positive spill-over effect as the more knowledgeable users support, encourage, and train their less experienced colleagues and eventually even apply pressure on those who are reluctant to adopt new techniques.

Educational programs that work with an entire college or academic department at the same time, such as Syracuse University's Faculty Computing Education Program, are an efficient way to use the computing center's instructional staff and a relatively rapid means of creating the desired spill-over effects and the mutual support that breeds self-reliance. Programs that provide learning experiences for graduate students, for example departmental graduate assistantships that provide, with the cooperation of the computing center, opportunities for graduate students to work with the latest or the most powerful devices, serve as a means of keeping an academic department in tune with developments in the computing center and eventually lead to the routinization of the interaction between the department and the computing center.

These and other such programs require a policy that encourages the academic computing center staff actively to reach out to the academic units to form these cooperative relationships and a funding structure that supports such programs by redirecting funds from centralized programs, if necessary.

This policy applies to office automation, as well. If the central computing center's office automation resource group attempts to provide in depth consulting and support on an ongoing basis to every department that purchases a microcomputer for word processing and other business functions it will quickly become overburdened and/or overstaffed. Here the need to foster self-reliance at the outset is crucial. The professional staff charged with supporting office automation must learn to create a realistic level of expectation in the prospective micro user with respect to the amount of time and training it will take for the individual or organization to be productive with the new device. The prospective user must understand the need to have someone in the unit who is capable of acquiring higher level computing skill with the new device, especially if networking is planned, and for the organization to come to terms with the fact in the future the users will need to devote time to dealing with the new technology. If there are a number of devices in the organization someone will have to be designated as the knowledgeable helper. Managers are slow to acknowledge these new obligations and roles within their organizations and the central resource support staffs tend to be myopic about gauging the learning potential and predisposition for failure in prospective micro users. People who are hooked on the power and capability of the microcomputer seem not to perceive that micros are an inappropriate and impossible solution for some individuals and organizations. Getting the "biggest bang for the buck" can lead to an awfully big bust when an individual or an organization is not ready to deal with the technology. We need to do a better job of formulating institutional policies and standards to acknowledge that there is a range of appropriate office technology and a range of abilities of organizations to benefit from its introduction. Nonetheless, the act of introducing a new technology obligates the individual and the organization to proceed actively toward self reliance in its use.

The Library and Converging Technologies

What will the future bring? It will NOT bring a merging of the library with the Information Systems and Computing division at Syracuse University. Although it is true that the library is moving inexorably closer to information systems in the services it provides, the creation of an organizational structure that joins two organizations with vastly different cultures and personalities is an artificial and perhaps even unworkable solution to a problem that need not be a problem. The contingency approach is applicable in this instance also. Syracuse University has formed a Technology and Technical Services Group with members representing academic and administrative computing and the libraries to ensure that the libraries are able to provide the community with access to information and information services.

The answer is to encourage flexibility in the institution's organizational culture by supporting arrangements that foster mutual support and cooperation. The support must come from the highest levels of the institutional hierarchy. The contingency approach works when directors and those who report to them feel secure enough in their positions to share some of their authority with colleagues in other divisions. In this age of technical convulsion, it is foolish to cling to traditional designs that rely on fixed structures, hinder cooperation, make any restructuring a traumatic and disruptive experience, and will not work in a constantly changing environment. Converging technologies require flexible organizations.

STUDENT COMPUTING AND POLICY ISSUES

Gerald W. McLaughlin

John A. Muffo

Ralph O. Mueller

Alan R. Sack

Virginia Tech
Blacksburg, Virginia

Prepared for CAUSE86
Monterey, California
December 1986

INTRODUCTION

The computer evolution is in full swing in today's elementary and secondary schools all over the United States. It has had an impact on colleges and universities wishing to remain viable educational alternatives. Institutions must consider the cost and benefits of development and implementation of comprehensive computing programs, facilities, and support networks. Institutions committed to addressing students' computing needs should follow a structured policy process: recognizing the present agenda; formulating the policy questions and developing alternatives; adopting and implementing a policy; and finally, evaluating the chosen course of action. This paper will help institutions to address important policy questions once the question "What should be the role of the personal computer in the modern day college or university?" has been asked, and show how feedback from students can help evaluate courses of action.

LEARNING FROM OTHERS

Literature available to help American universities and colleges develop computing policies is limited. Most articles deal with the subject in general terms, typically directed toward the effects of computing on faculty and students and not the underlying policy issues. One of the major reasons for the increasing use of microcomputers is the belief that they lend a more individual, personal, and flexible approach to learning than do the traditional classroom methods (Kulik, Kulik, and Peter, 1980; Miller, 1983). There is support that students will want to use PC's in various ways. These include: to rise their grades (Moore and Baxter, 1983); to do word processing (Woolston, 1984); and to better meet future situations (Misiaszek and Young, 1984). Unfortunately, these and other studies (Collins, 1984; Kellie, 1984) do not look at the policy implications of PC's.

Notable exceptions are articles by Gilbert and Green (1986) and Donald (1986). Gilbert and Green note that "Campus efforts to acquire and integrate technology raise complex issues at the heart of academic life. These efforts also involve significant costs" (p. 35). They discuss relevant issues and implications of computer usage in general terms and provide some insight into the problems and opportunities arising from the computer revolution on the American campus. Donald deals specifically with microcomputer policies adopted at Virginia Tech. He concludes that "The student microcomputer programs at Virginia Tech are successful" (p. 14) but at the end raises many policy questions which remain unanswered.

WHAT WE DID

The present study was conducted at Virginia Polytechnic Institute and State University, founded in 1872 as a land-grant college. Virginia Tech's 2,600-acre campus is located in Blacksburg, Virginia, and presently serves 22,000 students with a faculty of over 2,000. In 1983, Virginia Tech made the decision to require entering engineering students to purchase their own personal computer starting with the Fall quarter of 1984. It was the first public institution of higher education in the country to take the risk of having to face strong opposition from potential students, parents, or concerned alumni. It is projected that the number of personal computers at Virginia Tech will increase at a rate of about 3,000 machines per year (Donald, 1986).

A questionnaire concerning student computer usage was developed and administered by the Office of Institutional Research and Planning Analysis at Virginia Tech in the Winter and Spring quarters of 1986. The purpose was to provide policy and decision makers with the students' perceptions on computers at Virginia Tech. The wording of the questionnaire was drafted with the help of several faculty members active in computer usage matters on campus. Particular attention was given to the concerns of the College of Engineering and the Computer Science Department, since both of these academic areas require the purchase of personal computers.

The questionnaire was mailed to a random 10 percent sample of students who had been regularly enrolled undergraduates during the Fall quarter, 1985. To allow for subgroup comparisons, all computer science majors were surveyed as well. A follow-up post card, in addition to two more letters containing copies of the questionnaire, were sent to all non-respondents. An initial mailing of 2,149 questionnaires resulted in 1,693 usable responses out of 2,120 deliverable questionnaires, for a 79.9 percent response rate.

For purposes of an overall analysis, a 10 percent sample of the computer science majors was selected from the students' responses, so that the institutional totals would not be biased by the over-sampling of computer science majors. The result is a total of 1,244 responses used for the campus-wide data.

POLICY QUESTIONS AND RESULTS

Student Characteristics

A fourth of those responding used a computer at home while in high school. Most students (56%) using computers began in high school, while over a fourth (27%) first used a computer after graduating from high school. Prior to college attendance, the most popular computer activities were writing software (30%), playing games (23%), and running commercial software (19%). Only 1 percent have built computer hardware. Nearly 60 percent spent some time each week using computers in high school, with over one in ten spending six or more hours per week. Only 21 percent of the respondents attended computer courses, camps, or workshops prior to college, but over a third of these attended two or more such activities.

By the year 2000, according to the respondents, it will be most important for people in their career field to be able to use computers for statistical analysis or simulation studies, followed by data base management, word processing or text editing, electronic communications, and computer aid design. Of lesser importance will be program/software development, graphics or computer art, and spread sheet calculations. All of these areas, however, have mean ratings closest to "very important."

Which clientele should be served?

* If students are required to purchase a personal computer, during what year (freshman, sophomore, junior, senior, graduate) should the requirement be made?

Thirty percent of the students asked reported that freshmen should be required to buy a personal computer. Only a small percentage of students felt that a computer purchase should be required after the freshman year, whereas 53 percent felt that a PC purchase should never be required. These opinions were heavily dependent on student curricula with applied sciences most supportive of PC purchases.

* What impact would such a requirement or recommendation have on enrollment and recruitment?

Donald (1986) reported that applications actually increased after the policy to require a PC for all entering students was in effect. Furthermore, 32 percent of the students asked reported that a requirement would increase their willingness to encourage others to enroll at Virginia Tech, almost nobody said it would decrease their willingness, while the majority responded a requirement would not influence such willingness.

What provisions should be made for the curriculum, equipment, and supply?

Curriculum

* Should service courses or tutoring sessions be offered on a regular basis?

Students were generally satisfied with the help they received from fellow students, while they rated their satisfaction with help received from faculty and staff somewhat lower. This indicates that professional help should be available to the students, either in course form or through less formal tutoring. We may be seeing a lack of sophistication on the part of our faculty.

On the average students rated data base management and electronic communications as very important to their future careers, whereas 78 percent reported that they spend no time at all on data base management activities and 84 percent responded they have not used the computer for electronic communication. In the areas of program/software development, statistical analysis or simulation, and computer-aided design, the results are equally drastic. It is evident that in those areas, new courses have to be developed and offered as soon as possible.

Equipment

* Should students be required to purchase or use a personal computer?

As noted earlier, a large number of students supported such a requirement during the freshman year. Eighty-five percent of the students asked believed that students in their major should be required to use either a PC, the mainframe, or both, while 73 percent reported that they would buy a PC if it were "highly recommended." At Virginia Tech, the College of Business has recently advised incoming freshmen that the purchase of a personal computer is very highly recommended and access to a PC will be assumed for course assignment purposes.

There is a second part to this question. Many of our students are required to use computers for their course work and over two-thirds do so. At the same time, about one in two find computers useful in courses where PC use is not required. In fact, about half of the computer use at Virginia Tech is for other than required course use. This turns out to be some two hours per week of non-required use. By far, the most typical uses are text processing, programming, graphics, and games. The result of this usage is that most respondents reported that PC use improved learning, grades, and problem solving skills.

Those who would make computers available must be prepared for at least twice the demand created by courses and also understand that lack of sufficient resources may be seen by students as placing them at a disadvantage if they do not have adequate computer access.

* If the institution or the department does not require the purchase of a PC, should the institution or the department provide access to PC's through computer laboratories?

Almost half of the students surveyed use a PC on a regular basis. The majority (66%) take advantage of the printing facilities at the existing laboratories at Virginia

Tech. In general, students' satisfaction was neutral with regard to the convenience of the labs' location, the access to a computer, and the availability of assistance. On the average, they were satisfied with the dependability of the equipment. However, 30 percent of the students reported that they use a friend's PC, indicating that they largely depend on each other for computer access.

* Should it also be required to purchase certain peripheral equipment (printer, modem)?

Only 15 percent have their own printer and 20 percent use a friend's printer. This places a heavy load on institutional printers since over half use computers for text editing and doing their papers.

Virtually nobody owns a modem, but electronic communication is seen as very important for the future career. Clearly the institution must decide to provide access to modems if it wants to make it possible for students to acquire knowledge about electronic communication. However, at Virginia Tech the administration already raises concerns about increased mainframe access through modems. Computer time is expensive and easier access to the mainframe causes costs to increase. Even without a significant number of students accessing the mainframe from their dorm rooms, the number of modems has increased university-wide causing additional financial and mainframe-availability problems.

* Should the same software be required for all students?

Three main computer languages (BASIC, FORTRAN, PASCAL), and two main operating systems (DOS, CPM) are in use. Software usage seems to be discipline-specific with, for example, computer science favoring PASCAL, the sciences using

FORTRAN, and business oriented fields preferring BASIC as their main programming language. At large institutions it seems necessary to make software requirements department-specific rather than trying to find a university-wide solution.

* Should the institution support an electronic network for student computer communication?

Virtually nobody owned a modem at the time of the survey, and the vast majority (84%) of students surveyed spent no time on electronic communication while using a computer. Yet they report that this is one type of experience that they think is important. Before an electronic network should be established, the institution must decide on the availability of modems or other related communication software.

Supply

* Should the institution provide the student with the option or with the requirement to buy all equipment needed from the university?

The majority of students owning a PC (66%) bought the machine directly from the institution, while only 7 percent made their purchase through a local dealer. Less than 20 percent bought their PC from a non-local dealer, and virtually nobody purchased used hardware from an individual or ordered from a mail service.

* Should repair services be provided by the institution?

Over half of the students did not use any repair services, while about 30 percent used and were generally satisfied with the services provided by Virginia Tech.

CONCLUSIONS

The results of this study support that generally students are in favor of a policy which requires them to either buy or use a personal computer. However, many would purchase a PC if it were "highly recommended" rather than required. It is evident that if an institution is considering requiring students to purchase a personal computer, the students feel that the policy should be in effect at the beginning of the students' college career. The justification of an additional financial burden, effectiveness of necessary training, and usefulness of a PC during college years is maximized if the student gains knowledge through early experience. At Virginia Tech the influence of such a requirement in the College of Engineering and the Department of Computer Science was positive with regard to the number of applications received. Furthermore, a rigorous computer policy seems to encourage students to speak favorably of the university, which has a potentially positive impact on recruitment.

The data indicate that a variety of services should be provided by the institution to satisfy hardware, software, and support needs if computer use is required in courses. The requirement to purchase PC's creates new areas of need in which the university must invest thought, time, and money. At Virginia Tech, the students created their own support network. To a large extent they utilize a friend's PC and printer and receive help from other students. Service courses, computer labs, including printing and electronic communication facilities, software, and repair services are all part of the evolving needs and require attention from policy makers and administrators alike. These needs will basically be double the needs caused by required use in class.

A future-oriented university can take into consideration its student opinions when facing major policy issues which directly or indirectly influence all of its students. Asking for student opinions will not only identify direct and obvious implications of the to-be-adopted policy, but will also discover latent or implicit needs which otherwise would remain unaddressed.

APPENDIX

More Questions For Future Research

One study cannot address the multitude of questions about PC use. The following are some which await future work:

What provisions should be made for the organization, administration, and staffing?

* Who within the institution should have the responsibility and authority to enforce the set policies?

* Who within the institution should have the responsibility and authority to enforce the set policies?

* Who should teach the service courses? Who would be responsible for adequate tutoring?

* How much additional faculty and staff is needed?

How should it be financed?

* Should students pay for a required PC before entering the institution?

* Should the institution provide students with a PC and compensate through an increase in tuition? What would be the consequences for the availability of financial aid?

* Should institutions grant loans for the purchase of a personal computer? What would be the qualification requirements? Should the balance be paid before or after graduation? Should there be an interest charged?

* Who should pay for necessary repairs or maintenance of hardware and software?

* If the institution provides repair services, how will the additional space and manpower needed be financed?

* If the institution requires or offers the student to purchase hardware and software directly from the university, should the institution offer lower prices than the open market?

What provisions should be made for evaluation?

* If laboratories will be set up, should the institution (a) record the number of times a software package was used, (b) record the number of students using the services offered (equipment, tutoring), (c) determine the times of day or week when the majority of students use the facility?

* Should the institution or the department plan to conduct surveys on student and faculty computer use and satisfaction with the services provided?

REFERENCES

Collins, Michael A. J. (1984). Improving learning with computerized tests. *The American Biology Teacher*, *46(3)*, 188-191.

Donald, A. Wayne (1986). A successful microcomputer policy at Virginia Tech. *Cause/Effect*, *9(4)*, 10-14.

Gilbert, Steven W., & Green, Kenneth C. (1986). New computing in higher education. *Change*, *18(3)*, 33-50.

Kellie, Andrew C., Begley, T. R., Greer, M., & McLaren, John (1984). Experience with computer-assisted instruction in engineering technology. *Engineering Education*, May, 712-715.

Kulik, James A., Kulik, Chen-Lin C., & Peter, A. (1980). Effectiveness of computer-based college teaching: a meta-analysis of findings. *Review of Educational Research*, *50(4)*, 525-544.

Miller, Thomas W. (1983). CBE: Integrating video display and information processing. *EDUCOM Bulletin*, Spring, 14-19.

Misiaszek, Edward T., & Young, Thomas C. (1984). Use of personal computers at Clarkson for freshmen engineering students. *Frontiers in Education Conference Proceedings*, 262-264.

Moore, William R., & Baxter, Robert L. (1983). Microcomputers enhance engineering technology instruction. *Engineering Education*, May, 786-789.

Smith, Allan L. (1984). Using the Apple Macintosh to educate engineers at Drexel. *Frontiers in Education Conference Proceedings*, 272-275.

Woolston, Donald C. (1984). Incorporating microcomputers into technical writing instruction. *Engineering Education*, November, 88-90.

Track II

Planning and Information Technology

Forward-looking institutions which engage in effective strategic planning feel that they can anticipate and compensate for changes in the world of higher education rather than waiting for the future to happen to them. Because effective planning is complex, planners want access to the most up-to-date data. Papers in this track discuss experiences in planning for the future of information technology on campus as well as how information technology contributes to the analysis and integration of data necessary for decision-making and planning processes.

Coordinator:
Mary Sapp
University of Miami

Paul Costello
University of Miami

Lew Temares, University of Miami;
Judith Leslie, Maricopa Colleges;
and Gerald McLaughlin,
Virginia Tech

Jim Penrod
CSU/LA

CAUSE 86

STRATEGIC PLANNING FOR INFORMATION RESOURCES MANAGEMENT

Putting the Building Blocks Together

James I. Penrod, Vice President for Information Resources Management
California State University, Los Angeles
5151 State University Drive
Los Angeles, California 90032

Michael G. Dolence, Management Systems Analyst
California State University, Los Angeles
5151 State University Drive
Los Angeles, California 90032

ABSTRACT

Cal State L.A. began in 1985 to fulfill the mandate of change in management of its information resources by hiring a Vice President for Information Resources Management, reorganizing existing units into an IRM organization, engaging in a detailed integrated participative strategic planning process, and initiating several very significant projects. This paper explores the steps taken, problems encountered, future challenges and the critical success factors of a campus undertaking such activities. Major projects for the new organization include a new Administrative Information Management System, an integrated voice/data telecommunications system, over 800 new instructional microcomputers and a variety of academic minicomputer projects.

I. The Setting

The California State University (CSU) is comprised of 19 campuses that enroll more than 325,000 students, served by more than 37,000 faculty and staff. Together they make up the largest "University" in the world. The extended CSU campus stretches 1,000 miles from Humbolt in the north to San Diego in the south.

The California State University, Los Angeles campus, founded in 1947 by action of the California State Legislature, has become a comprehensive university offering programs in more than 50 academic and professional fields. The six Schools of the University house a total of 49 academic departments and serve more than 20,000 students distributed among the Schools of Business and Economics, 25%; Natural and Social Sciences, 17%; Health and Human Services, 14%; Engineering and Technology, 11%; Arts and Letters, 10%; and Education, 5%, with another 18% undeclared majors. Nearly one third of the University's students are engaged in postbaccalaureate study.

Located in northeast Los Angeles, its primary service area is ethnically diverse, economically mixed, and encompasses many of the Los Angeles basin's business, industry, and government districts. Cal State L.A. is, thus, an urban, multicultural institution that is somewhat unique within the 19-campus CSU. It is one of the most multiethnic universities in the nation -- 32% White, 28% Asian Pacific, 25% Hispanic, 11% Black and 4% American Indians and other non-Whites. Over 20% of its students are immigrant residents, while another 5% hold visas or refugee status. One in six students have been in the United States for less than six years. Six of ten students work half-time or more, and over half are part-time students.

The campus employs 1,365 faculty members and 908 full-time staff members. Educational and service needs currently are provided within a $75,515,540 State fund and $16,458,220 non-State fund budget (FY 85/86).

II. A Mandate for Change

During the last few years, Cal State L.A. has been developing and evolving an information resources management program to support the University mission, goals, and objectives. Most saliently, a campuswide Presidential, blue-ribbon task force spent 18 months examining campus needs and resources for information technologies. On February 14, 1984 the group suggested that, "In order to assure the most effective deployment of resources currently expended on information resource functions, the Task Force recommends that a senior level Office for Information Resources be permanently established..." [1]

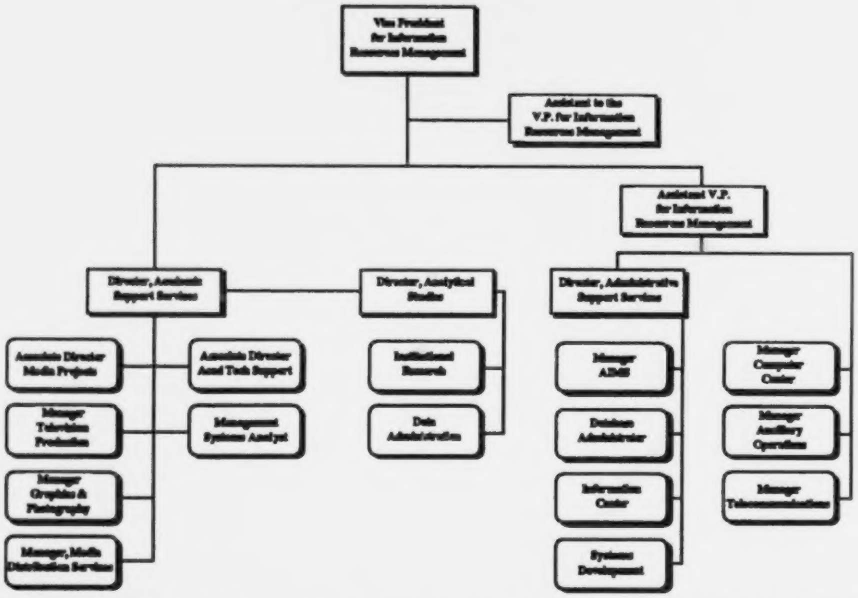
The Task Force was asked to make detailed recommendations regarding what the unit should look like and to identify fund reallocations. It delivered its final report in September 1984, identifying positions (96) and budget ($5.5 million). After review by various campus constituents, the search was begun for a Chief Information Officer (CIO). [2] The position was advertised: "Under general direction, the Vice President for Information Resources Management is responsible for executive guidance, direction, and policy for a comprehensive and integrated Information Resources Program including the following: Administrative Information Management Systems (AIMS) Development, Instructional Media and Information Services, Information Management Support Services, Data Processing and Network Operations, Telecommunications Management and Ad Hoc Systems Implementation."

The Information Resources Management (IRM) unit was brought to life by the President in July 1985. This newly-created unit is one of less than 200 such units among the nation's over 3,000 institutions of higher education.

Through the leadership of the new Information Resources Management unit, the campus has undertaken the creation of an IRM organizational structure with the development of mission, goals, and objectives among its first tasks. Their development has been based on the belief that there are cornerstones for success. "These cornerstones [for implementing an IRM] are (1) defining the IRM concept in the context of the organization where it is to be implemented, (2) establishing governance for the management of information resources, (3) developing a strategy that defines the organization's unique information architecture and the desired environment for information resources, and (4) establishing the appropriate level of technology standards that will allow the desired environment for information resources to be realized." [3]

It is important to emphasize here that the organizational structure is one that includes not only staff assigned to the unit, but also campuswide participation of academic and administrative representatives, in shared responsibilities of planning, priority-setting, and implementation of information resources. The mission, goals, and objectives of IRM likewise reflect the results of campuswide observations and commentary and are formally reviewed annually.

IRM Organizational Chart, Cal State L.A.
December 1986


Vice President for Information Resources Management
Assistant to the V.P. for Information Resources Management
Assistant V.P. for Information Resources Management
Director, Academic Support Services
Director, Analytical Studies
Director, Administrative Support Services
Associate Director Media Projects
Associate Director Acad Tech Support
Institutional Research
Manager ADMS
Manager Computer Center
Manager Television Production
Management Systems Analyst
Data Administration
Database Administrator
Manager Ancillary Operations
Manager Graphics & Photography
Information Center
Manager Telecommunications
Manager, Media Distribution Services
Systems Development

IRM functions are accomplished through four major organizational units: the Vice President's Office, Academic Support Services, Operations, and Administrative Support Services. This structure provides campuswide support in Academic Computing, Media Services, Institutional Research, Planning and Analysis, Networking, Telecommunications, Ancillary Services (Mail Services, Reprographics, Administrative Manual, etc.), Office Automation, and Administrative Computing. An evolutionary movement toward an information utility is planned. The developed utility will focus on a mix of services and products, place emphasis on client involvement, provide education and training for a standardized "tool box" of applications, stress the participatory prioritization of services, provide maintenance for the campus network and associated standardized devices, and lead the strategic planning for information resources.

Three major projects currently are being developed and implemented: Telecommunications, Administrative Computing, and Academic Computing.

Cal State L.A is in the process of procuring a new digital telecommunications system. The current environment is comprised of a Pacific Bell Central Office Centrex for voice communications and a Gandalf PACX Port Selector based data network. The Centrex serves approximately 2,200 phones for faculty and staff use. The data network functions over a twisted pair copper wire cable plant serving approximately 450 terminals. The new system will integrate a new voice data switch with upgraded versions of current data switches. The new digital switch based system (scheduled for cutover in March 1988) will support approximately 3,000 voice lines plus 400 data lines. Over the subsequent 5 years, up to an additional 1,200 data lines will be installed to support both academic and administrative needs. High speed computer-to-computer communications will be provided. The network will support X.25 and local area networks such as Token Ring, Starlan-3BNET and Ethernet. There are two coaxial cables that terminate in each building on campus to support video capabilities.

The foundation of the campus' existing administrative computing environment is based upon technology and thinking that are over twenty years old. These systems were designed to provide information for the administration of both the campus and the CSU system, using an electronic data processing approach.

The new AIMS philosophy, that of an Information Utility, contrasts with the current "data-processing" environment in several ways. It uses impact on individuals as a productivity measurement criterion as opposed to machine cycles, while shifting some of the responsibility for systems development from the conventional programming staff to a broader-based, end-user community. This information utility involves interactive, relational databases that the University community will use by employing system development tools, productivity tools, and modeling tools, and provides for the development and perpetuation of secure data and system integrity. The information utility will be designed to provide a base for administrative systems founded in new technology, developed in new concepts, and supported by modern tools.

The Academic Computing Plan and strategy are based upon the campus course-by-course assessment of student access requirements with input from School committees and the IRM faculty advisory committee. These mechanisms will ensure that available resources are applied to develop a target environment that meets specific curricular demands.

The current academic computing environment consists of 2 CYBER mainframes and 14 supermini/minicomputers. As of June 1987, there will be 428 student workstations with plans to add another 556 workstations by 1991. Local Area Networks and Wide Area Networks are being installed in existing labs and will be utilized in new labs.

Adequate student access must be paralleled with adequate faculty access. Cal State L.A.'s goal is to provide a microcomputer based workstation for each full-time equivalent faculty member. In addition to the question of access to machines, the issues of access to training and development, provision of adequate ongoing consultation services, and provision for the acquisition of appropriate software to meet instructional needs, must be resolved. [4]

III. Beginning the Planning Process

Campuswide long range planning is being developed simultaneously with the IRM unit. The CIO currently leads the coordination of the process for the President. The campus has transitioned from an informal rebound process to a strategic orientation resulting in the adoption of a formal planning model. "During the past year it became obvious to the Long Range Planning Task Force that the adoption of a formal planning methodology, which has proven to be successful in other higher education environments, would be extremely useful at Cal State L.A. Various models exist, but the methodology used perhaps most in successful planning endeavors in colleges and universities has been developed by Dr. Robert Shirley..." [5] The Shirley methodology as adapted to Cal State L.A. calls for the development of 10 tactical plans, one of which is IRM.

The CSU system also requires information resources planning through its annual Campus Information Resource Plan (CIRP) process. A CIRP plan from each of its 19 campuses is then compiled into a system plan driving State budget requests. At Cal State L.A. the CIRP provided a rather detailed, organized plan as a foundation on which to build the IRM plan. Interestingly, neither one of the primary architects of the campus CIRP had been associated previously with the computer center. The foundation for the CIRP rests upon a course-by-course listing detailing 483 courses in which over 16,000 course/students require 56,503 contact hours per week for an average of 3.43 hours each. Based on the assumption that each workstation is schedulable for 53 hours per week, the campus needs 1,066 workstations to fulfill its course-by-course demand. The target environment must accommodate not only the total demand but the mode of utilization taking into account that some courses may necessitate hands-on workstation experience in the classroom setting while others need access to workstations outside of scheduled class time in order for students to complete assignments or laboratory work. The course-by-course listing reflects faculty assessments of the required access time a student enrolled in each course would need to fulfill specific course assignments. Adjustments are made as curriculum analysis and revision takes place in each of the six Schools. [6]

A number of political constraints face planning and implementation of a new IRM organization. Cal State L.A. is part of a large State system, it has limited resources for which there is great competition, it is a nontraditional campus with unique needs, and it experiences strong faculty involvement in planning and administration. Other realities include the Governor's cap on the number of State employees, the mandate to serve a specific geographic area, the primary mission as a teaching institution, and the annual State budget cycle. The IRM Strategic Plan as developed through a participative process helps enormously by focusing political negotiations on an integrated strategic direction for IRM in which each constituent has a stake.

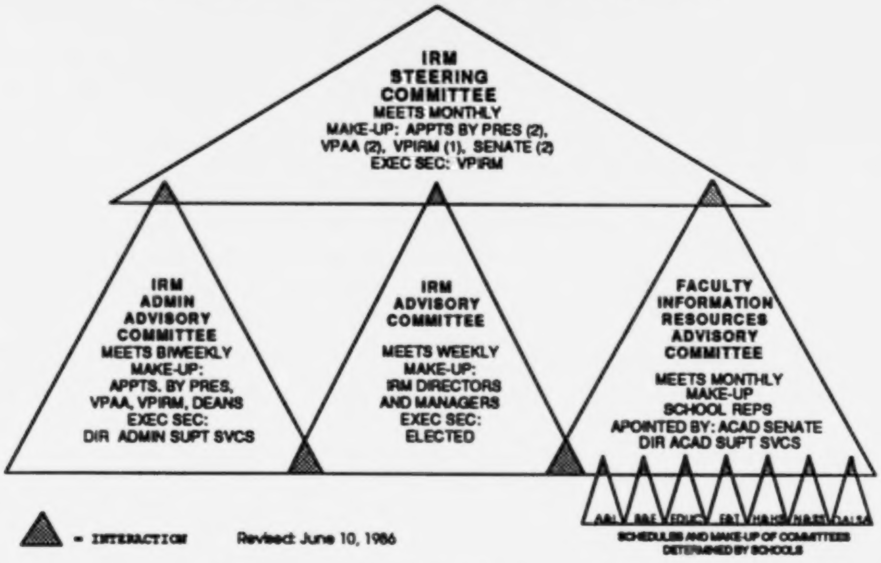
IV. Avoiding "People Problems"

Information Resources Management has developed a participative organizational decision structure composed of four interrelated IRM committees, each of which is integral to the successful implementation and operation of information technology systems at Cal State L.A. The structure, employing Likert Linking Pin Theory, has been used and fine tuned over a period of years at other institutions of higher education. [7]

The **Information Resources Management Steering Committee** assumes a fundamental role in providing representative, campuswide advice on IRM strategic planning, policy, procedures, and standards at Cal State L.A. The Steering Committee meets monthly and consists of eight members. Two members are appointed by the Academic Senate; two are appointed by the Vice President for Academic Affairs; two are appointed by the President; and one, the Chair, is appointed by the Vice President for Information Resources Management. The Vice President for Information Resources Management serves as Executive Secretary.

The **Faculty Information Resources Advisory Committee** is charged with the following responsibilities related to academic information resources: provide advice on all academic projects; prioritize projects in support of instructional programs; suggest areas where policy may need to be created or revised regarding academic programs; assist in the evaluation of IRM units; and advise on priorities for distributing resources in support of curricular activities. The committee meets monthly and its membership consists of school representatives appointed by the Academic Senate, with the Director of Academic Support Services serving as Executive Secretary. Each School also has an IRM advisory committee.

Cal State L.A. Committee Structure for Information Resources Management


IRM
STEERING
COMMITTEE
MEETS MONTHLY
MAKE-UP: APPTS BY PRES (2), VPAA (2), VPIRM (1), SENATE (2)
EXEC SEC: VPIRM
IRM
ADMIN
ADVISORY
COMMITTEE
MEETS BIWEEKLY
MAKE-UP:
APPTS. BY PRES, VPAA, VPIRM, DEANS
EXEC SEC:
DIR ADMIN SUPT SVCS
IRM
ADVISORY
COMMITTEE
MEETS WEEKLY
MAKE-UP:
IRM DIRECTORS AND MANAGERS
EXEC SEC:
ELECTED
FACULTY
INFORMATION
RESOURCES
ADVISORY
COMMITTEE
MEETS MONTHLY
MAKE-UP
SCHOOL REPS
APOINTED BY: ACAD SENATE
DIR ACAD SUPT SVCS
A&L
B&E
EDUC
E&T
H&HS
SCHEDULES AND MAKE-UP OF COMMITTEES DETERMINED BY SCHOOLS
▲ = INTERACTION
Revised: June 10, 1986

The **Information Resources Management Administrative Advisory Committee** is charged with the following responsibilities: provide advice on all administrative projects; assist in Needs Analysis Report (NAR) development; prioritize administrative work orders; determine appropriate membership for administrative project task forces; develop new administrative procedures where needed; suggest areas where policy may need to be created or revised; monitor administrative projects and work plans; and assist in evaluation of IRM units. The committee meets biweekly and its membership is determined by appointments by the President, Vice President for Academic Affairs, Vice President for Information Resources Management, and Deans, with the Director of Administrative Support Services serving as Executive Secretary.

The **Information Resources Management Advisory Committee** (IRMAC), which meets weekly, is composed of IRM Directors, Associate Directors, and Senior Managers. IRMAC has developed the following charges, emphasizing its involvement in six key areas: assist in policy recommendations; assist in procedural development; develop recommendations on operational standards; resolve problems in administrative areas of concern; develop resource allocation plans; and evaluate IRM operations and services.

Reporting lines and personnel needs are driven by defined IRM functions in the planning process. The goal is to achieve a fully functional, integrated organization. Several "new functional niches" including data administration, planning coordination, special development projects, and maintenance management, all were added based on defined needs.

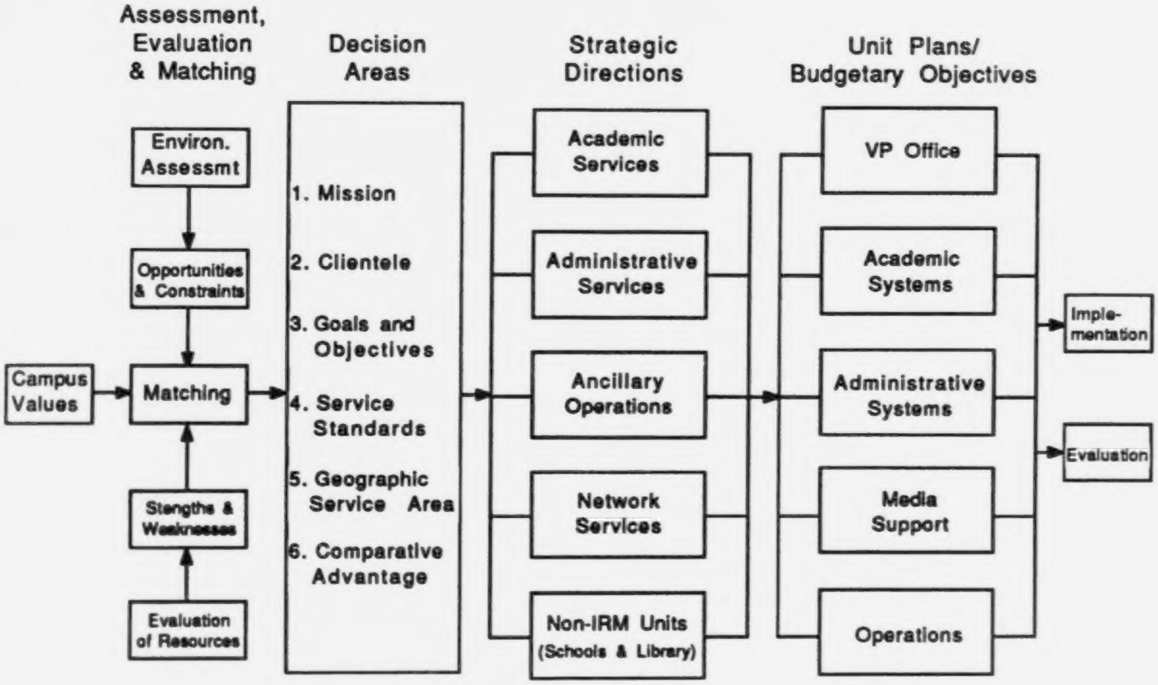
Once the organizational needs are identified, supportive structures are created and existing staff is realigned functionally. The focus then turns to recruiting staff with different expertise than that to which the campus may be accustomed. In Cal State L.A.'s case, some existing vacant positions were redefined to meet urgent campus needs, and these "new" positions (i.e. Assistant Vice President, Data Base Administrator, AIMS coordinator, and Telecommunications Manager) will add critical expertise to the campus' resource base. Several other critical positions do not exist within the organization -- for example, academic consultants, administrative user liaisons, systems development manager, and maintenance personnel, as well as a complete telecommunications infrastructure. There also is a need for additional student lab assistants so that instructional computing lab hours may be increased and new labs covered. At Cal State L.A. each position must be reallocated either from IRM or other campus units.

Creating a new IRM culture was considered key in getting the newly realigned units to function as a cohesive division. IRM employs an administrative model that embraces the concepts that management primarily derives its authority from knowledge, skill and achievement, and that decision making, rather than being the sole prerogative of administration, is most effective when it occurs among people closest to a particular activity. A participative committee structure is used to provide overall guidance for implementation of major projects. A matrix approach to problem solving is felt to be most effective and is utilized routinely. Planning that leads to the development of goals and measurable objectives which then are appropriately evaluated is emphasized. Teamwork in decision making and ongoing operation within the unit and with other organizational units is essential. The importance of role definition, a balance between organizational and individual needs, rewards tied to productive performance, and the necessity for personal integrity are recognized as elements integral to good administration. Senior staff is encouraged to maintain an "open door" policy, and ombudspersons are employed to promote goodwill and a results-oriented operation.

V. The Plan

The development of the IRM Strategic Plan also was patterned after the "Shirley" model. The model, as adapted to IRM, called for an analysis of strengths, weaknesses, and environmental trends to feed a matching process relating external opportunities and constraints to internal strengths and values. The matching provided the basis for development of an extended mission statement, the delineation of clientele, the development of goals and objectives, and the establishment of an appropriate program service mix. These parameters then formed the basis for guiding the development of individual unit plans.

IRM Planning Model for Cal State L.A.


Assessment, Evaluation & Matching
Decision Areas
Strategic Directions
Unit Plans/ Budgetary Objectives
Environ. Assessmt
Opportunities & Constraints
Campus Values
Matching
Strengths & Weaknesses
Evaluation of Resources
1. Mission
2. Clientele
3. Goals and Objectives
4. Service Standards
5. Geographic Service Area
6. Comparative Advantage
Academic Services
Administrative Services
Ancillary Operations
Network Services
Non-IRM Units (Schools & Library)
VP Office
Academic Systems
Administrative Systems
Media Support
Operations
Imple-mentation
Evaluation

To feed the matching process, IRM compiled a list of 19 trends, six strengths, and eight weaknesses, all of which impact the institution's future. The trends include: Information technology will increasingly impact curricula and the teaching and learning processes. Decreases in traditional enrollments and funding for education will result in a need for more effective administrative processes and productivity. Rapidly advancing technologies are fostering increased linkages between universities and industry. Hardware capacity will continue to grow, allowing software developers to make available increasingly powerful software tools. The rates of change in hardware and software, and the advent of converging technologies, will require continued institutional attention. Growing numbers of increasingly sophisticated users will necessitate expanded technical and consultative support. Ethical and legal issues regarding the uses of information technology will demand increasing institutional attention. The continuing impact of the divestiture of AT&T will result in incremental increases in telecommunications costs.

One of the most profound strengths identified is the University's deeply felt and widely-recognized need to improve information resources. The new IRM organization institutionalizes an approach that recognizes information as a basic resource which requires effective administration. The backbone of the campus' future data network is a new integrated voice/data telecommunication system now in procurement. The campus has a rich mini/super-minicomputer environment primarily for academic usage. The AIMS commitment will bring a significant increase in the quality of the campus administrative computing system. Overall, the IRM staff is well-educated and motivated. Existing IRM physical facilities are adequate for the current environment. Through its capability to produce high quality media materials and its extensive media software collection, Media Services assists the University in maintaining a strong institutional position.

Weaknesses, once identified, provide a focus for IRM attention and corrective measures. For example, communication channels, both formal and informal -- so necessary for success in IRM -- needed significant improvement (IRM began publishing the IRM News). Campuswide standards for hardware, software, and security are needed (IRMAC became the forum for coordination). Administrative procedures were inadequate and many written procedures did not exist (addressed through IRMAC). The involvement of the University community (i.e. end users) in the development of the IRM program (i.e. information technology projects) largely has been inadequate or inappropriate (being addressed by the committees). An integrated information technology maintenance program including media equipment, telecommunications, microcomputers, terminals, and peripheral devices is needed (A pilot unit has just been established). The CYBER mainframe computer is inadequate for administrative needs (Addressed in AIMS). The Gandalf Port Selector Network is inadequate to meet future data transmission needs (Addressed in the telecommunications project).

Cal State L.A.'s mission and goal statements are long-range in nature, while the objectives are stated in terms of the fiscal year. The IRM mission includes statements involving service delivery structure, governance, and direction; service responsibilities and obligations; and responsibilities to IRM staff. As is appropriate, Cal State L.A.'s mission, goals, and objectives are documents upon which campuswide consensus is sought.

The primary mission of the IRM organization at Cal State L.A. is to foster the communication process of the institution; to provide planning and technical guidance in the integration of varied, new, and existing campus information technologies; and to provide leadership in the efficient and effective use of a vital university resource -- information. IRM's fundamental purpose is to provide, within the context of the University's mission, the highest quality information service to the campus community that allocated resources will allow. In providing services to support instruction, research, administration, and public outreach, the unit acts as an agent of change with implicit accountability to its clientele. IRM is committed to develop human as well as technological resources. In so doing, it continually seeks ways to further the goals of the campus and the CSU.

The success of IRM planning is enhanced by soliciting broadbased participation in the planning process and providing vertical integration of the IRM plan into the campus Strategic Plan. A recognized need to improve the decision process is addressed by ensuring that decisions are made in a timely manner, at the most appropriate level, and with a view to the interests of the institution as a whole. Human resources development extends beyond the efficient and effective use of existing resources to cultivation of an IRM organization "culture". IRM has made a major commitment to improve not only the quantity and quality of services, but also to maintain an alignment between services needed and those provided which is ensured by establishment of evaluation mechanisms. Smooth development and operation of broadbased IRM support systems such as telecommunications, the campus television system, and central computing systems also are supported fully by the goals and objectives. There are 20 stated goals, bolstered by 85 specific objectives, in the IRM Strategic Plan.

VI. Challenges and Opportunities

A number of challenges faced the new IRM unit at Cal State L.A. as it implemented a change methodology. The methodology facilitated transition from a group of diverse units to an IRM organization. The first step was the assembly of the existing management team to discuss the purpose and theory behind implementation of an IRM program. Then, in group sessions, the team evaluated, selected, and adopted a planning model. Planning then was focused on identification of functions that IRM needed to perform. Old units were reshaped into new IRM components based on the functions adopted by the team. The results were summarized in the IRM Strategic Plan and circulated for review. Comments and suggestions were incorporated, where appropriate, and the new IRM organization began implementation of an information resource management program.

Transition strategies require a clear and concise idea of the target environment. They must be politically sensitive but factually based and technologically sound. At Cal State L.A. both staffing and funding must be assembled from existing resources, so it is imperative that IRM manage its resources well. It is also imperative that the investments guided by IRM are productive and stand up to the test of cost benefit analysis.

The IRM budgeting and funding profile is somewhat unique. Sources of funds include direct allocations to IRM, allocations from other units on campus, lottery funds, research funds, instructional equipment replacement funds, and special programs (such as CSU Television Network). So, rather than a finite budget over which IRM has control, expenditures for IRM are a complex web of sources under a number of control units which must be mixed and matched, negotiated and coordinated, managed effectively and efficiently, and martialed toward meeting the information resource goals of the campus. A primary distinguishing factor is the "institutional" budgetary thrust undertaken by IRM as contrasted with a more common "departmental" budgeting perspective. Several new instructional microcomputing laboratories, for example, required School funds, IRM funds, Lottery funds, donations, and equipment funds to implement. Pulling together these diverse resources maximized the use of available dollars and resulted in high impact laboratories otherwise unfundable. In this manner, IRM is gaining experience with "pushing the edge of the envelope" through creative strategies and packaging investments.

VII. Conclusion

Factors critical to the successful implementation of IRM at Cal State L.A. are:

TOP MANAGEMENT SUPPORT: The recommendation to establish an IRM came from a Presidential task force. Commitments by the President, Vice President for Academic Affairs, School Deans, Department Chairs, and the Academic Senate must continue and intensify as questions of University mission, campus policy, and resource allocation vis a vis information resources management are confronted. A commitment from the CSU is necessary as Cal State L.A. moves forward with AIMS and the telecommunications projects.

PROJECT LEADERSHIP: The two primary development projects for IRM are the digital telecommunications system and the Administrative Information Management System. Each project will rely heavily on a task force comprised of both technical staff and users. Success is dependent upon campus constituents taking an active role in planning and implementation.

PARTICIPATIVE PLANNING: The IRM unit must continue to build upon the strong participative planning infrastructure already established.

SIGNIFICANT USER INVOLVEMENT: IRM must rely on continuous user input and evaluation to ensure that the services provided meet user needs. Users also have a responsibility for meeting their information needs.

EDUCATION AND TRAINING: The campus must commit to significant training of all users -- faculty, staff, and administrators.

PROCESS, POLICY, AND PROCEDURE DEVELOPMENT: IRM must derive a full methodology for developing process, policy, and procedures vis a vis information resources management and applications development.

TIMELY TELECOMMUNICATIONS INSTALLATION: Key to the success of the Cal State L.A. Digital Telecommunications System is the ability of the campus to establish and support a telecommunications organization appropriate to the needs of a utility which the campus is implementing.

FUNDING (External and Internal): Implementing an information utility will involve significant resources. IRM must continue to "push the edge of the envelope." Funding for telecommunications and partial AIMS funding has been secured from the CSU. Continuing operating resources for these systems must be provided by the campus. Increased resources also must be made available to the Schools and Departments and the Library to implement the significant information technologies planned.

The development of an IRM program is an evolutionary path. At Cal State L.A. we have had three organizational charts in a year. The next stage in the evolutionary process is a change in thrust from setting up the organization (accomplished this past year) to the campus implementation of new systems (a focus for the coming year). On the more distant evolutionary horizon is the establishment of an information utility.

REFERENCES:

1. Final Report: President's Task Force on Information Resources, California State University, September 1984.
2. Penrod, James I., "A Case for the Chief Information Officer," CAUSE/EFFECT, Vol. 8 No. 5, September 1985, p.3.
3. Ray, Mel, "Information resources management: four cornerstones for implementing IRM," INFORMATION MANAGEMENT REVIEW, Fall 1986, pp.9-15.
4. Gardner, David Pierpoint, "The Charge of the Byte Brigade: Educators Lead the Fourth Revolution," EDUCATIONAL RECORD, Winter 1986, pp. 10-15.
5. Penrod, James I., A Report to the Campus: Strategic Planning at Cal State L.A., Fall 1986, p.4.
6. CAMPUS INFORMATION RESOURCE PLAN: 1986-1991, California State University, Los Angeles, May 1986.

7. McCredie, John W., *Campus Computing Strategies*, "Pepperdine University," John McManus, James Penrod, (Bedford: Digital Press, 1983) pp. 67-93.

Planning for Administrative Computing in a Networked Environment

Cynthia S. Cross
Marianne J. Elser
Renee W. Frost
Cheryl W. Munn
Jill B. Tuer

The University of Michigan
Ann Arbor, MI 48109

ABSTRACT

The University of Michigan has embarked on a major effort to transform its information technology environment to one which is network centered, workstation based, server enhanced, and software integrated. This vision is widely accepted on campus, but its viability depends to a large extent on creating an information network which ties together the various computing resources now in use by the University community.

Past planning activities of the Office of Administrative Systems have resulted in the development of centralized data bases supporting operational activities and providing valuable information to departments, support for acquisition and use of personal computing resources and office automation tools, and the development of an integrated voice and data network. This paper will discuss the evolution of the Office of Administrative System's planning direction and its focus for the coming year on assisting the academic departments to plan and implement effective use of information technology. Included will be a discussion of the organizational and strategic issues addressed in the plan as well as the specific user-oriented services required for its success.

Planning for Administrative Computing in a Networked Environment

I. FORCES OF CHANGE

II. PREVIOUS PLANNING ACTIVITIES

  A. Management Information System Planning

  B. Office Automation and Personal Computer Planning

  C. Voice and Data Networks Planning

III. COMPUTING RESOURCE ON CAMPUS TODAY

  A. Hardware and Software

  B. Networks

  C. Data Resources

  D. User support services.

IV. VISION

V. AN ADAPTIVE MIGRATION STRATEGY

  A. Planning for Integration

  B. Promotion of Existing Services

  C. Facilitating Access and Delivery

  D. Providing New Functions

  E. User Support Services

VI. ISSUES

PLANNING FOR ADMINISTRATIVE COMPUTING IN A NETWORKED ENVIRONMENT

FORCES OF CHANGE

Computing technologies have become critically important to universities and colleges. It has been said many times that ours is a knowledge industry and our business is information. We create, manipulate, store and distribute data. Computer technology has become an integral part of our world because it allows us to do all of these activities faster, more efficiently, more effectively, more accurately and sometimes for less cost. However, because of our very dependence on computers, developments in computing and telecommunications drive change affecting our organizational structures, our instructional and research methods and our management systems. Many factors over which we have little control are influencing the direction and the amount of change which in turn must be integrated into our organizations.

First, there are several external factors which push us toward altering our use and approach to information technology. Initially and most significantly is the rapidly developing technology which may seem to go through "generations" overnight. The day of the large standalone mainframe is history. Today networks are the key to delivering computing power and communications capabilities to the desk top. Digital switching technology, new wiring schemes, standardized protocols and communications models allow for the design and building of products which move data, as well as voice and computing power, to wherever the user desires. Workstations are becoming increasingly faster and more powerful. The "3M" workstation is readily available and at a cost that is no longer prohibitive. The existence of wordprocessing packages, electronic spreadsheets and database management applications mean that almost anyone can justify the use of a microcomputer. All of this technology is available at a price we wouldn't have believed possible in 1950 or even 1970. The cost of the hardware is decreasing by a factor of ten every decade. As technology becomes less expensive, it can be used more intensively.

Coupled with this rapid change in technology is the fact that the competition for the student enrollee is intensifying among the top colleges and universities. In order to remain viable it becomes clear that a university, with pretensions to superiority, cannot maintain itself and ignore computers, networks, workstations or application software.

Within the University of Michigan the following changes are occurring. The Information Technology Division (ITD) was formed almost two years ago in order to draw together the resources of the academic and administrative computing centers, the Merit Network office and the Telecommunications Systems office. This consolidation and the appointment of a "computer czar" has focused attention and resources on planning for and using of information technology in all areas of the University. Even before the organizational consolidation, the University embarked on a "smaller but better" approach resulting in budget reallocations. This program has compelled faculty and administrators to look to savings through the use of computers. Further, it has made them even more critical of the cost and effectiveness of central computing resources.

Two years ago, the University decided to become its own telephone company. The installation of a new multi-million dollar switch with all new wiring and telephone sets is complete and operational on the main campus in Ann Arbor. Along with providing digital voice capabilities, capability for simultaneous digital data transmission is now provided to each office via a dual telephone jack.

After 10 years of development, the central administrative databases are readily available for use by all university, school and college administrators. The user community is aware that computers are very powerful and can do "almost anything". Consequently, we must either provide easy access to centralized university data or the users will do it on their own using microcomputers. Messaging systems are in widespread use as evidenced by a new Provost and Vice President for Academic Affairs who communicates almost entirely using electronic memos and messages. The lesson here is that the demand for access to messaging systems will increase, as will the demand for bridges and gateways between the various systems now in use.

At the University of Michigan we have attempted to respond to these external and internal forces of change by instituting a wide range of services and programs. These greatly affect the academic and administrative staff as well as the students. These programs currently include providing public microcomputer facilities for members of the University community; providing request accounts for staff, faculty and students on the academic mainframe computer; providing a purchasing mechanism for selected microcomputers; utilizing software purchase agreements; creating partnerships with vendors to integrate their diverse products within the information technology environment of the University; providing training and educational opportunities for the entire University community; and providing a wide range of specialized and general consulting services, as well as other projects.

PREVIOUS PLANNING ACTIVITIES

Management Information Systems

Planning for a Management Information System at the University dates back at least as far as the mid-1960s; the "take-off" to sustained systems development did not occur until the early 1970s. The key elements shaping this development were the organizational structure, the technological constraints, and the funding mechanisms. Unifying the whole was a vision:

> "a Management Information System is an assemblage of people, services, and devices forming a network for the purpose of producing and delivering information needed by managers. The information produced must be reliable and suitable, and must meet the needs of University administrators at all levels in the administrative, academic and auxiliary units." (OAS Report 1974, p. 5)

By 1974 the University established an organizational structure to define needed database and systems development and recommend priorities. The key participants were the Supervisory Groups and Task Forces which recommended priorities for development and reviewed designs for specific projects. Significant attention was paid to inter-office compatibility and interfaces between systems.

In addition to the organizational structure, other strong centralizing forces were at work: the size of the databases being contemplated required a mainframe, acquisition of mainframe computers was controlled centrally, and development costs of approved projects were paid for from central University funds.

While the long range goal of the Office of Administrative Systems (OAS) has always been to provide support for the operational, management and planning functions of the University, it was noted in a 1978 study that "the database development has been treated more as an end in itself than as the means to better management decision-making."(OAS Report, 1979, p. 4).

This situation was clearly not compatible with OAS own definition of its goals and mission:

> "to serve the administration of all units: central administration, the schools and colleges, independent academic units, and auxiliary organizations." (OAS Report, 1974, p. 5)

The result of observing this dichotomy was that OAS turned its planning efforts towards providing centrally-maintained data in usable form on the desktops of the decision makers in the schools and colleges. This has proved a challenging task. We now are beginning to see that a combination of new technological possibilities and new funding, as well as a shifting of the organizational focus of OAS, will allow us to complete the task we set for ourselves two decades ago.

Office Automation and Personal Computing

During the late seventies, it became apparent that office automation was becoming a viable option in the data processing arena. In order to ensure integration with other University information systems, comprehensive functionality, and an appropriate level of automaticity, OAS embarked on the task of automating the office within the University environment. The outgrowth of this planning process was the implementation of a scheme which provided for the purchase, installation and support of Wang Labs, Inc. OIS shared-resource systems. OAS purchased a number of OIS CPUs and placed them in buildings on campus. Departments purchased their own workstations and printers, and, in return for an initial hookup charge and a monthly maintenance fee, were provided free training, systems and software maintenance, and connectivity to the administrative mainframe.

The Personal Computer revolutionized the working environment for data processing everywhere and the University of Michigan was no exception. Purchasing agreements were signed with four different PC vendors, Zenith, IBM, Apple and Wang, which provided for the sale of large volumes of PCs very inexpensively to University Faculty, Staff and Students. Support services were established for faculty and students through the Microcomputer Education Center (MEC), a joint venture of the academic computing center and the School of Education.

Planning for Voice and Data Networks

Planning for University wide data communications networks began in the 1970's. Several planning groups consisting of faculty and administrators were established and the final report, issued in 1983, recommended that "UMnet should be developed as a geographically broad-based, multi-technology backbone network under the management of a single University organization." Concurrently with the issuance of this report, OAS decided to proceed with the installation of a WangNet local cable network. Thus 4 coaxial cables plus a fiber optic sleeve were installed connecting all buildings on the main, north and south campuses.

Several events during the early 1980s sparked a desire to investigate the possibility of replacing the existing University telephone system. The first step in this process was the formation of a Voice Systems Task Force in the spring of 1983 whose members were charged with the responsibility of identifying the specifications for a new telephone system. As a result of the efforts of this task force, it was decided to move toward the implementation of a University-owned and operated telecommunication system.

COMPUTING RESOURCES ON CAMPUS TODAY

Hardware and Software

The University enjoys a rich and varied hardware environment. In the "Mainframe Era", some control of diversity was exercised by a central policy committee which reviewed proposed purchases with an eye to efficient use of University resources. Control of PC acquisitions has mostly come through the "carrots" of lower prices and service availability for "supported" products. However, the size and diversity of activities on the campus naturally requires a variety of systems to support many particular needs.

The academic Computing Center has recently installed an IBM 3090-400 and uses a shared real-time operating system, the Michigan Terminal System (MTS), first developed at the University in the late 1960s. OAS relies on the IBM database products running on an IBM 3083 processor. OAS runs standard IBM 3270 bisynchronous terminal communications and MTS uses asynchronous protocols. As increasing numbers of faculty and staff need to go both places, connectivity poses problems Gateways and protocol converters can overcome the obstacles, but at a cost in equipment and administrative complexity.

In the years following the 1979 consultant's report, OAS concentrated on completing the task of building the foundation databases and operating support systems and finding or developing the software infra-structure necessary to distribute data and computing facilities to support all administrative functions on campus. SAS, ASI, MarkIV, and RAMIS are installed on the DSC mainframe and are available to customers who want to do their own ad hoc reporting.

The advent of PCs offered OAS both a challenge and an opportunity. The challenge came from the ease with which departments could set up their own independent administrative systems. The PCs offered an opportunity to use cheap processing power to utilize the vast resources of central administrative data. Providing good facilities for data subsetting and downloading is a top priority in the new OAS Information Center. ASI query has emerged as our preferred tool to select data from large hierarchical databases. More recently TEMPUS-LINK has been identified as the best download-upload tool for our heterogeneous population of hardware and connections.

The combination of the recently installed TOPSECRET Security software, which requires User IDs and profiles for each individual employee, and the OAS developed Access Control Facility allow OAS to distribute access to sensitive information, with a high degree of confidence in its security.

Networks

In July 1984, the University of Michigan Regents awarded a 31.7 million dollar contract to Centel Business Systems for equipping and installing a University-wide telecommunication system. The system architecture includes a Northern Telecom DMS/SL-100 switch and 27,000 voice and data lines. Capability for simultaneous digital data transmission at speeds up to 19.2 kbs is provided at each desk and residence hall room via a dual telephone jack. The system is operational on the main campus and will be implemented on the two regional campuses next spring.

In addition to the capabilities provided by the new telephcommunication system, there are many general and specialized networks on campus. Three major ones are UMnet, the Office Systems Network and the Data System Center (DSC) Network. The largest of these networks is UMnet which is a packet switched network using technology developed at the University for the Merit Computing Network. The Office Systems Network is a proprietary broadband cable network from Wang Laboratories, Inc. covering 9.5 miles and is in almost all buildings on campus. The benefits of this network to University departments include document and data transfer between Wang systems and application and hardware resource sharing. The DSC network is an IBM 3270 network with a variety of hardware and software components that access the administrative (DSC) mainframe computer. Access may be via either IBM 3270 compatible controllers or protocol converters. The protocol converters also serve as gateways into the DSC network from UMnet.

Data Resources

A wealth of information is currently available at the desktop for use by departments and in the schools and colleges. The Admissions System is designed to support the processing of all University admitting units, to provide academic departments needed information on applicants to their graduate programs, and to provide undergraduate units information on newly admitted students. Comprehensive student demographic and academic data and university course information can assist any unit reporting on, tracking, or needing to contact students and in course-section planning activities. Alumni and donor information is available for fund-raising units. Departmental faculty and staff responsible for managing and monitoring accounts and for preparing financial reports can utilize financial information. There is data on University buildings and structures accessible by facility managers. Individuals responsible for the administration of a unit's personnel and staff benefits can access personnel data and up-to-date directory information is available to all staff. Those who track departmental purchases and invoices can utilize purchasing inquiries. An online system for ordering from University Stores is also available. At present, this vast data resource is mainly available at the desktop via formatted inquiries. Some data is set up for departmental access and reporting with ad hoc query tools. Subsets of the information are also made available for use in personal computers, though the mechanisms to allow direct access and subsetting are not all in place.

User Support Services

As a result of technological advances and the proliferation of microcomputers, the OAS organization was restructured in early 1985 to address the needs of the end user. As a part of that reorganization, the Information Systems Services (ISS) Division was established. The goal of ISS is to enhance and facilitate the use of mainframe data by providing end users with the necessary tools, information and knowledge needed to access the centralized databases maintained on the mainframe.

ISS consists of three units: Office Systems, the Communication Assistance Center and the Information Center. Office Systems provides hardware and software support for the Wang systems on campus. The Communications Assistance Center helps OAS users work with the network hardware by providing problem analysis and resolution.

A variety of services for the user are provided within the Information Center (IC). An IC hotline is available for end users who need an immediate response to a data access, hardware or software question. In addition to formal classes, the IC educational arena also provides online tutorials, hardware and software demonstrations, customized training, training documentation and help clinics. The IC consultants assist with everything from accessing established database queries to downloading and file transfer as well as hardware, software and connectivity issues. Finally, the IC planning team assists Schools, Colleges and departments in accessing the mainframe resources and in defining long range plans for systems development, networks and connectivity.

User Support Services at the Computing Center are addressed in four different areas; education, documentation, consulting and user relations. A Departmental Consulting and Planning Office, established within the User Relations area, is working closely with the Information Center planners to provide the University community with comprehensive systems access, planning and development in both the academic and administrative computing arenas.

VISION

Our vision of the future is a totally integrated networked environment characterized as being network centered, workstation-based, server enhanced, and software integrated. The network will provide storage as well as transportation, will provide compatibility with the multivendor environment and will be ubiquitous. There will be at least a one to one relationship between a cost-effective, multi-function workstation and faculty/administrator/student desiring access to the network. Various types of servers will be available for archival, computational, database/library access, output, artifact production, and other specialized functions yet to be developed. For all these pieces to be effective and useful, the environment must be software integrated. The software will have portability and present a single-system image to the user. Such an environment will allow a user to use the hardware and software of her choice to access a network, allowing her to send a message to another user on campus or around the world with a simple "send to John Doe" command.

Moving toward this environment is an evolutionary process. Many of the components are already in place today but others do not yet exist. Our new telecommunications project provided a totally new distribution system. A combination of transmission media (copper wire, coaxial cable, microwave links and fiber optic cable) were installed to provide for current and future needs. Many units on campus have already installed their own local area networks. Others are eager to do so but are waiting for guidelines as to compatibility requirements. Thousands of workstations exist in offices, homes, residence halls and public sites. But not everyone who needs one has one, nor do they all have the connectivity necessary. Servers exist in the forms of various hosts mainframes, minicomputers, and printers scattered around campus, but connectivity cannot be easily or cost-effectively achieved in most cases. The diversity and incompatibility of operating systems and application software make information access, messaging, and file transfer cumbersome and costly.

To achieve this vision of the future, planning is critical. Project teams have been assigned by the Vice Provost to study, in depth, various aspects of the desired future environment and to recommend directions, development projects, and products to facilitate the transition. A new division within ITD, called the Center for Information Technology Integration (CITI), was created to help us research this goal through participation in joint development projects with vendors who are building the products which will make this vision a reality. The University community is an excellent environment for developing and testing leading edge technology because of the expert faculty and staff, the diversity of existing technology and future needs, and the scale of expected use.

AN ADAPTIVE MIGRATION STRATEGY

Planning for the Integration of Information Technology

One of the challenges facing departments on campus today is to select the proper mix of the many components of information technology now available to them. Departments desire access from a personal computer workstation to multiple network services residing on different hosts. The traditional administrative system user is now interested in messaging and conferencing systems available on the academic mainframe and the traditional academic user is now interested in using appropriate administrative data. It is important for those responsible for assisting in departmental planning to be aware of the full set of resources available within the Information Technology Division. ITD provides centralized high-level consulting services to assist departments in these planning efforts. The three goals of this planning effort are: to make the best use of the full set of resources within ITD in assisting units become more productive, to feed the needs of the departments back into the system planning process for new or improved systems and services, and to enable collaboration among departmental efforts.

Functional responsibility for departmental planning lies within the OAS Information Center. The planning team currently includes three staff members from OAS and two staff members from the Computing Center. With over 55 combined years of experience, this group not only has expertise in many areas themselves, but are aware of who the subject matter experts are within ITD.

The focus for this group in the coming year is to assist the academic units and departments plan for the use of information technology in the workplace. Improvement in the efficiency of departmental operations and the effectiveness of management decisions by incorporating information technology in the workplace will provide benefit not only to the units but to the University as a whole.

This team provides planning support to schools and colleges to assist with equipment and software selection and purchase, network connectivity planning and implementation, local network planning, mainframe service selection, information planning and data access implementation, training needs assessment, and consultation on personnel and management issues relating to automation. Most schools have established or are in the process of implementing a computing committee with a charge to plan for use of information technology within the unit for instructional, administrative, and research related activities. Some of the schools are also hiring individuals to be responsible for implementing their unit plans. The growth of expertise in technology within the units is being encouraged.

Promotion of Existing Services

Communications and network connections must be provided expeditiously to encourage administrators to become familiar with currently available technology and to prepare them for using future technology. We are working to provide the optimum network connections for the usage desired. This requires using the current technology in a way that will also fit into the long-range plans.

The majority of the main University administrative functions are now supported by large integrated database systems. These systems support the main operating units in carrying out the business of the University; they are controlled, stable, and secure. These systems also provide a valuable data resource to faculty and staff within the schools, colleges, and individual departments. We are encouraging workstation access to the administrative information currently available. Our strategy is to emphasize direct utilization of the data resource by the enduser to support their unit operations, management decisions, and strategic planning needs.

Facilitating Access and Delivery

Although we have a good base to provide users access to the data, projects to enhance the student, staff, financial, and alumni-donor databases in order to provide increased function to departmental administrators and faculty are now in progress. This implementation will not only benefit the user but will reduce the number of one-time information requests now causing a backlog with administrative application programmers.

Efforts to integrate departmental databases with institutional information systems have begun. Information Center consultants provide diskettes of class list information each term to academic departments. Various data is downloaded to personal computers on request. Staff are currently implementing file transfer software for use with IBM compatible personal computers and are investigating improvements for file transfer to Wang systems. Endusers will have increased capability to access central data for which they have been authorized. Requests for modification of regularly scheduled reports to provide files suitable for downloading have been received. Information collected and processed on personal computers will also be uploaded and input into batch database updates. This change necessitates the development of appropriate and controlled procedures within the application programming and information center environments.

We continue to strive to provide a "seamless" network and application interface for our users. Our users complain about the number of screens they must pass through and the number of system identifiers and passwords they must remember in order to utilize database transactions and electronic mail systems. Efforts to alleviate these nuisances while providing adequate control mechanisms are underway. Implementation of Top Secret is almost complete. An interface between Top Secret and our "home grown" access control facility used to provide subsets of institutional data has been developed. Planning for overall network security mechanisms have begun.

A task force of administrative systems personnel has identified our specific requirements for a relational database package. Our goal is to increase the productivity of the administrative application developers, to speed the process of database enhancements and modifications, and to provide enhanced mechanisms for end user computing.

Providing Functions via Networks

Completion of the primary database systems must still occur. The development of an academic record system and a new student accounting system are needed and underway. Fund raising activities are now carried out in the schools and colleges and the demand for gift dollars has never been greater. The existing alumni and development system does not meet the need of this decentralized environment and needs restructuring. A University system to support research activities and grant administration is needed.

A system to provide electronic preparation and routing of documents is now being developed. This system will allow paper forms to be replaced with electronic forms, will route documents for obtaining authorizations, and will provide input to various operational systems. This system will use the network to transact the business of the University. Food stores ordering, purchase requisition processing, and personnel budget processing are but a few current paper systems that are planned for electronic document transfer.

User Support Services

The need for administrative user support services has never been greater. Immediate plans to enhance support to administrative users include: providing training support at the user's workstation to help and encourage use, developing improved written and online documentation, adding to the number of consultants available to assist with information retrieval and use, increasing staffing for first-line telephone assistance and troubleshooting, increasing emphasis on research and development of mechanisms to facilitate end user computing, introducing an Information Center User Group and associated newsletter for all administrative end users, and activating an ITD user services project.

ISSUES

Many issues still need to be resolved. A great number of issues revolve around funding. What services in such an environment should be charged back to the individual units on a usage basis? Which services should be supported by central funds? Which services merely subsidized? How does the University support such a massive move to new, expensive technology? Personnel resources are required as is the space to house these resources. Support from a top administration vitally concerned with academic excellence, continuation of research activities and funding of basic services is required. Coordination across campus of an ever growing number of activities and decisions is an absolute necessity. And above all, we must cope with and accept the challenges offered by a changing technology.

LONG-RANGE STRATEGIC PLANNING IN A DECENTRALIZED ADMINISTRATIVE INFORMATION SYSTEMS ENVIRONMENT

William M. Gleason
Director of Resource Planning

John C. Moldovan
Director of Administrative Information Services

Virginia Commonwealth University
Richmond, Virginia 23284

Abstract:

The paper describes the process and experiences associated with strategic planning in a recently decentralized administrative information systems environment. Background information on why the University decentralized the authority, responsibility and accountability for the delivery of administrative information services to major administrative units is presented. The key facets of the decentralization plan are described including the creation of a senior staff position to coordinate the planning for university-wide administrative information services, management reporting and decision support and the development of a long-range strategic plan. The formulation of the plan includes the development of planning assumptions, critical issues, goals, objectives and strategies for administrative systems, communications, management information, office automation and central computing services. The changing role of the computer center and the development of departmental computing is also discussed.

LONG-RANGE STRATEGIC PLANNING IN A DECENTRALIZED ADMINISTRATIVE INFORMATION SYSTEMS ENVIRONMENT

Setting the Stage for Decentralization

The hardware and software realities of the 1970's and early 1980's necessitated a university administrative computing environment that typically focused on a central group responsible for the planning, development/selection, implementation, operation, maintenance and control of all administrative application systems. These units generally concentrated their efforts on the primary administrative application systems such as the financial accounting system, the student information system or the payroll system. The "batch" mode of processing predominated and while many talked of integration of data and data bases, the few that attempted it found it to be a traumatic experience that did not deliver what they had hoped for.

Concurrent with the ascendance of the central administrative computing department, was the realization in the administrative operating units that many of their information needs could be satisfied through the use of the computer. In fact, this "information explosion" was fueled by the computer industry with promises of increased productivity, better decision making, and lower costs. Unfortunately, the results were more negative than positive. Operating units increased their levels of expectation beyond what the machines and programmers were able to deliver. The demand for data, reports, and modifications to systems soon far outpaced the ability of the central ADP department to meet it. We had entered the age of the "backlog". Some experts predicted that many organizations had backlogs of 2-3 years, an almost insurmountable barrier. But reports of these backlogs did nothing to appease the appetite for more and more information or changes to application systems. Computer software companies capitalized on the situation by touting products that "increase programmer productivity" and "eliminate development backlogs".

In some instances, the "backlog" was the result of inadequate increases in resources available to the ADP department and a lack of control over the information demands. While some institutions did make inroads into this quagmire, many attempted to blame the "user" for the problem. Departments requesting system modifications or data reports were often forced to plan requests and design reports months in advance. Changes meant further delays and frustrations. Those requesting changes often had little control over the environment causing the change but were often labeled as poor planners and managers by the ADP department for not anticipating these changes.

The realization that predicting internal and external changes and anticipating information needs is difficult at best in a dynamic environment helped to bring the problem into focus. The problem wasn't entirely poor planning or inadequate ADP resources. Ineffective, cumbersome and outmoded software and hardware were also major contributors to the problem.

The advent of fourth-generation languages and microcomputers in the mid-seventies has done much to put computing in the hands of the user, yet, in its own way, has contributed to yet another era of rising expectations. The central ADP departments have steadily lost their control of the allocation of computing resources. These new software and hardware tools have enabled the computer literate user to access institutional data that was previously untouchable without technical assistance from a programmer or analyst.

Another interesting development was emerging; the growth in "end-user" computing. Was the traditional centralized ADP department still the only game in town? Were the economic and security justifications for centralized ADP services still viable? Are there other options?

ADP Decentralization at Virginia Commonwealth University

Virginia Commonwealth University (VCU) is a state supported institution with an enrollment of approximately 19,500 undergraduate, graduate and health professions students and 3,900 faculty and staff. The university was formed in 1968 through the merger of the Medical College of Virginia, founded in 1838, and the Richmond Professional Institute, founded in 1917.

Unlike most large, research-oriented institutions, VCU did not evolve with separate academic and administrative computing centers. Instead, until recently, the academic and administrative areas shared a single, central IBM host computer. Academic computing did, however, have some independence in computing with several satellite academic computing centers providing access to a mini-computer.

Until 1985, the management of the central computer center, academic computing and administrative data processing was centralized under the Computing and Information Resources organization. This unit reported to the senior vice president for administration. The central computer center then had a staff of twenty-two, academic computing had twenty-one positions, and administrative data processing had thirty-five on its staff for a total of seventy-eight.

In some respects, VCU had operated in a quasi-decentralized administrative computing environment since the mid-seventies. The student information system and financial aid system were operated and maintained under the direction and control of the University Enrollment Services unit which reported to the provost. However, the other major administrative application systems such as the financial accounting system and the payroll/personnel systems were the responsibility of the central ADP department.

In 1981, VCU approved a five-year plan for administrative data processing. The plan included an extensive list of projects that were to be initiated and completed during that five-year span. The primary thrust of the plan was to replace most of the major administrative applications systems or make major enhancements to the existing systems.

Probably the most critical need in 1981 was to replace the seriously outmoded payroll and personnel systems. Both systems were "home-grown" and had undergone extensive modifications over time. These systems represented significant barriers to increased productivity and improved services at the university. The decision was made to buy an existing integrated human resources system "off-the-shelf". The advantages were the reduction in development costs, a faster implementation schedule and reduced maintenance costs since the vendor would provide software upgrades and enhancements. The administrative data processing unit was responsible for the implementation of the acquired system.

In 1983, after more than a year of false starts and project delays, a decision was made to shift the responsibility for the implementation of the human resources system from administrative data processing to the administrative unit most concerned about the project, the financial operations unit. Staff from the administrative data processing unit and other administrative units (e.g., Personnel, Planning & Budget) were assigned to this project, some temporarily and some permanently. The human resources system responsibility was shifted to the Personnel Department at the completion of the implementation.

The human resources system implementation proved to be an unqualified success. It demonstrated that the implementation of a major administrative application system could be accomplished under the direction of the operating unit with the related functional responsibility. It paved the way for decentralization.

In the spring of 1985, the university embarked on another major administrative application system implementation, the financial records system. This implementation effort was the first to occur under the newly approved "Plan for Decentralization of Administrative Information Systems and Services".

The Decentralization Plan

Decentralization and centralization are not mutually exclusive choices; they can coexist. The difficulty is in deciding what functions and processes are best managed in a decentralized mode versus those that are best managed in a centralized manner. In our case we have clearly decentralized the management of our administrative information applications systems by making them the responsibility of major administrative units.

While the management of the administrative applications systems is decentralized, the systems themselves are not distributed systems. The primary administrative systems reside and function on the central host computer rather than on distributed computers located and controlled in functional departments.

Essentially the plan calls for the "authority, responsibility and accountability for administrative services and related information systems" to be distributed to the chief administrative officers for the major areas of Financial Operations, Enrollment Services, Employee Relations, Facilities Management, Public Safety and Business Services, Planning and Budget, and University Advancement. Administrative functions within academic units such as university libraries, deans' offices and academic central administration were to also be included under the administrative decentralization umbrella. The primary objectives of the decentralization plan are:

- To improve the effectiveness of essential administrative services;
- To enhance the management of administrative information systems;
- To encourage the integration of information services into each administrative function in the university.

The administrative areas affected by the decentralization plan have the following functional responsibilities:

- Development/acquisition of new or replacement application systems;
- Operational integrity and accuracy of production systems;
- Maintenance and enhancements of existing systems;
- Information requests including ad hoc reporting, audit inquiries and other information requests;
- A shared responsibility with other administrative areas in the development of an administrative services strategic plan.

The central administrative data processing unit was dismantled and the personnel and budget were distributed across the administrative areas assuming the added ADP responsibilities. However, the central computing and communication services were not totally decentralized. The central computer center retained the responsibility for production control and scheduling, technical consulting, technical data base management, and procurement support for office automation.

To provide overall coordination of the planning and delivery of university-wide administrative information systems, services and management reporting, a senior staff position, the director of administrative information services, was created. This position reports to the associate vice president for planning and budget. More specifically, this individual's primary responsibilities are:

- Coordination of the development of the university's administrative information systems plan;
- Participation in the selection of administrative applications software systems;
- Planning and coordination of the university's management reporting and decision support systems;
- Data base administration coordination;
- Data administration including evaluating the quality, integrity and use of data elements in the university's administrative systems' data bases;
- Developing policy recommendations for standards and procedures concerning administrative information systems, services and related management reporting activities.

A committee structure was established to support the decentralized environment. The focal committee, the Administrative Information Systems Advisory Committee (AISAC), has representation from each of the administrative areas affected by the decentralization including the university libraries, deans' offices and central academic administration. AISAC is chaired by the associate vice president for planning and budget. The committee advises the associate vice president for planning and budget and provides leadership and direction in the continuing development and coordination of the university's administrative information resources.

A subcommittee to AISAC was also formed to deal with the operational and implementation issues concerning administrative information systems, services, and management reporting. This group is made up of technical managers from the various administrative areas. The subcommittee is chaired by the director of administrative information services who reports on subcommittee activities to AISAC.

Need for an Updated Plan

Let's review a few salient points which have been made thus far that pertain to the systems planning process. The University has a long history of planning. Institutional priorities which include broad long range goals, shorter term objectives and specific strategies have been prepared for years. In addition, the budget process is well established and quite sophisticated. Information systems is also no stranger to planning. As we mentioned earlier, a five year information systems plan was prepared in 1981 which included a very ambitious list of projects.

For various reasons progress in implementing the plan was not progressing at an acceptable rate. As a result, system development responsibility was decentralized and has proven to be a successful solution for decreasing the application backlog. At this point in time about half of the original projects have been implemented or are in the final stages of implementation. Since many changes have occurred over the last several years the remaining projects are in need of review and re-evaluation. It should also be noted that the 1981 plan concerned itself only with application systems.

Different Approach to Planning is Needed

Although decentralization is an effective solution for solving the application backlog problem a number of factors require careful attention.

Incompatibility. As each department is proceeding independently in addressing their system development needs there is a real danger that the resulting systems could be incompatible. Undoubtedly, data created in one department needs to flow to other departments; it would be advantageous not to have to re-enter this data. Perhaps even more important is the ability for various schools and departments to be able to easily access and manipulate data regardless of where the data resides.

Replication. There is a tendency to replicate overhead or support functions since each department is accountable for controls and procedures in developing and operating their systems. This tendency highlights the need for standard procedures to eliminate duplication of effort.

Central functions. Certain functions are central in nature. Perhaps the most prominent example of such a function is the administration of data. Since a great deal of the same data is used by various systems it is a distinct advantage to have a central planning function that is responsible for such things as data architecture, elimination of duplication, and uniform definitions. Provisions need to be made to identify these central functions and assign clear responsibility for them.

Parochial views. Identifying and resolving issues that affect more than one department becomes a very difficult task. The very nature of decentralized responsibility promotes a parochial view on the part of the functional departments. Departmental managers find themselves overwhelmed by the job of managing the new information resources and are not inclined to look for additional tasks outside their realm of responsibility.

Due to these factors, and changes in priority, reassignment of personnel, and changing technologies it had become necessary to prepare a new information systems plan. Agreement had also been reached that the plan needed to be strategic in nature and could not be limited to just application systems. Which specific issues to address, what planning methodology to use, and who to involve in the planning process was, however, not clear.

Identifying Critical Planning Factors

Crucial to the success of the planning process has been the ability to understand the organizational factors which would influence it.

Management style. One way to characterize our management style and our strategic planning is to call it "pragmatic". Executive management stays involved in all activities by setting broad agendas and delegating specific authorities to senior management. On the other hand, wide participation in the management process is fostered by establishing advisory committees that make recommendations to senior managers up the line. The result is a flexible, participatory type of management that can draw on all resources of the university as needed.

Departmental independence. Departmental managers were enjoying their newly found freedom by proceeding relatively independently with their system development efforts. Since the same managers were the key to developing a viable, central information systems plan it was crucial to get them to participate in the planning effort. They needed to see the importance of identifying and addressing issues that impacted on all of them.

Committee membership. AISAC members are very busy managing their departments and their relatively new data processing function. They have committed two hours per month to the regularly scheduled meetings. Any more time is considered too much of a burden on their schedule. In addition, there is some uncertainty as to the role of the Operations Subcommittee. On one hand, AISAC wants the Subcommittee to initiate recommendations, on the other hand the Subcommittee is looking to AISAC for more direction. As we gain more experience the interaction between the committees is improving and more time is spent on substantive issues rather than on procedural matters.

Planning Process

Plan outline. Considerable research was done to find a planning model which could be adapted to meet our needs. A number of CAUSE publications were ordered and reviewed. The content and organization of our plan were based on those documents and the University of Miami's plan which they were kind enough to share with us.

Methodology. With a planning outline in place we needed to decide on a planning methodology. The AMA seminar "Long Range Information Systems Planning" helped put the various formal planning techniques into perspective. BSP (Business Systems Planning) and Nolan's Stages of Growth methodologies were rejected on the basis that they were too lengthy and too costly, CSF (Critical Success Factors) was rejected because it is too quick and would not yield enough details to lead into action plans.

The methodology we chose is based on the planning process the university uses to develop the Statement of Institutional Priorities from which the university establishes its goals and objectives. The process consists of identifying broad issues and planning assumptions, refines these into goals (5-6 year planning horizon) and objectives (2-4 year planning horizon), and then defines specific strategies (1-2 year planning horizon) to achieve those goals and objectives.

Participants. Although developing the plan is the responsibility of the Planning and Budget Office the planning activities need to involve all those affected by the plan. Since the AISAC members represent all administrative activities they are the logical choice for doing the planning for administrative systems. Although there has been fair representation on AISAC we are investigating having more direct representation by the Library and the Provost's Office.

Problems Along the Way

Progress had been quite satisfactory for the first six months of this exercise. We had brought the senior staff member on board, the committees were starting to meet regularly, and we started the planning process. We had selected a planning methodology, a plan outline, and the persons who were to participate in developing the plan. With all the tools in place we were ready to roll. We had started to pick up momentum and anticipated to continue to do so but instead experienced a number of dramatic delays.

Other priorities. Administrative departments were forging ahead with plans to improve their systems. As a result, a number of major system procurement requests were waiting to be reviewed by AISAC. We discovered that we needed a process that insured compatibility between the systems and involved the AISAC and the Operations Subcommittee. Consequently, a great deal of time and effort went into developing procurement review procedures for administrative systems and the reviews of the procurement requests themselves.

Conflicting schedules. Due to the normal burdens of departmental management and the additional systems responsibilities AISAC members' schedules were already overburdened. It became clear that in order to make faster progress more time needed to be devoted to the planning process. This presented a real dilemma to the members.

Needs assessment. Needs for system development work had in the past been expressed to the central data processing staff. After decentralization the major administrative departments provided for their own needs. However, their are a number of administrative functions, such as the Provost's Office and the Dean's Offices, that cannot afford their own data processing staffs and still need support. At this point these offices do not know who to call on for support and AISAC has not yet resolved how to deal with this issue.

Varied expertise. Degree of familiarity with and interest in technical issues varies a great deal among committee members. Time is required to acquaint members with current technology and related issues. To convince some members that their participation in the planning process is really important is sometimes difficult.

Expediting the Process

Despite the problems we still felt that the planning approach was sound. We had been striving for a few short, highly productive planning sessions with the AISAC members that would yield the major thrust of the plan. It became clear to us that the reason for our limited success was that the AISAC leadership conducted the sessions. We needed the services of a facilitator who was not part of the planning group.

After interviewing a number of consultants we agreed that the person we needed had to be familiar with our environment. We were very fortunate to find a member of our academic administration who is an expert in group dynamics and was willing to work with us. The committee agreed to a series of three half-day planning sessions, moderated by the facilitator, that followed the outline of the plan. Each session was preceded by a separate meeting during which background material for the upcoming planning session was to be provided.

Using a facilitator from within the university has been very successful. Everybody's focus suddenly shifted from within the group to the outsider, the result of which was more freedom of expression and increased participation. All of this was enhanced by the facilitator's skills.

The Final Product

Only after extensive discussions did the following objectives of the plan become clear:

- The plan must help the University achieve its mission. To that end the plan needs to be strategic in nature and based on the institutional goals and objectives.
- The plan must lead to specific actions. Consequently, a pragmatic approach was needed and the gap between the conceptual foundation and the actual project plans had to be bridged.

- Needs must drive the use of technology. New technology should not be used unless it is clear that it will address specific needs and the costs are justified.

Guided by these objectives and considering a number of existing models resulted in the following outline of the plan:

I. Introduction. This section describes our past planning activities and the sponsorship and objectives of the current plan.

II. Planning Assumptions. Broad statements about the objectives of the plan are made in this section and create the basic foundation for the material that follows. (e.g. Access to information, including the converting of data into information, will become the central focus in administrative information systems planning.)

III. Issues. These are expressions of what the planning group considers to be the most important administrative systems topics that need to be addressed. We identified end user computing, interconnectivity, and centralization vs decentralization as the major issues and elaborated on each one by providing a description and a discussion of various aspects of each.

IV. Goals. The stage is now set for closing the gap between the conceptual and the actual by using the background in the previous sections to develop specific goals in all areas of information systems. For that purpose the broad area of information systems was divided into:

Applications Systems
Information Management
Departmental Computing
Central Computing
Communications
Security
Organization

V. Strategies. With this background we are now in a position to examine current technology to decide on alternative solutions to improve our current environment. We are constantly asking ourselves where we want to be within the next several years and what technologies we want to employ during that time period. As in the previous section, the approach is organized by developing strategies for applications systems, information management, departmental computing, central computing, communications, security, and organization. In addition, each set of strategies is preceded by a description of the current environment to insure a common understanding of our starting point.

Getting the Plan Approved

Consensus for the plan by all AISAC members is the primary requisite for obtaining executive management's support. In order to arrive at consensus varying points of view need to be discussed and reconciled. Presumably, the members are in the best position to make recommendations in this area and through this process are given ultimate freedom in making choices. It also frees up executive management to address higher level agenda items by reviewing recommendations which have the full support of the AISAC.

The final step in the approval process will be a wide circulation of the plan to all major University administrators for comments, incorporation of those comments and submission of the plan to the President's Council for formal approval.

PULSE: AN "OFF-THE-SHELF" DECISION SUPPORT SYSTEM AT DICKINSON COLLEGE

RONALD E. DOERNBACH

DICKINSON COLLEGE
CARLISLE
PENNSYLVANIA

PULSE is the nickname given to Dickinson's on-line, executive level information system. Authorized staff are presented with data screens on their terminals organized by broad subject area. Readers receive new screens when they read their electronic mail and may retrieve old screens from on-line files. Readers may also communicate to reporting offices and request clarification or further information while logged on to the screen in question. The system was designed to use existing electronic mail commands and required no additional expenditures for staff, hardware, or software.

Background and Project Origin

Dickinson College is a small, private, independent, highly selective liberal arts college located in Carlisle, Pennsylvania. When founded in 1773, the College was conceived as institution primarily for the preparation of scholars, lawyers and clergy. Today, its 167 faculty prepare some 2,000 students in over thirty different academic disciplines ranging from the classics to computer science. The College´s 20% growth in enrollment over the past decade has made management by its forty-six administrators increasingly more complex and technologically more sophisticated. Administrative computing began in 1966. In 1974, the College installed its first time-sharing computer, a DEC PDP 11/34 and simultaneously delivered computing power to virtually all administrative offices. By 1977, the College developed its own electronic mail system called DREAMS which is still in use today. In 1986, academic year, the College´s computer center was providing computing service to the entire College community from two networked mainframe systems - a DEC PDP 11/84 for the administration and a VAX 8600 for academic users. On the administrative side, all administrators have either a terminal or a microcomputer on their desks. The major applications are word processing, data base inquiry, and electronic mail. In the latter area, use of electronic mail has become more important than the telephone for on-campus communications. Most administrators access their mail account several times a day to receive or send messages.

Despite this relatively high level of computer literacy and usage, senior administrators often complained that more time was spent sorting through data to ascertain the facts than was spent making decisions. Most important issues were addressed with a combination of previously prepared routine reports, *ad hoc* papers and last minute verbal updates. The mix of information sources used usually meant that no senior officer had the same information base as another on any given issue.

Objectives

It was in July of 1985, and in the context of the situation described above, that the President and senior staff asked for a solution to the information problem. The objectives were broadly outlined and included: a confidential executive level information base, timely updating, distribution to a limited group (see Fig. 1), and simultaneous delivery of important changes. Ironically, given our familarity with the computer and electronic mail communications, the suggested delivery system was a loose-leaf fact book which would have required frequent and annoying maintenance.

PULSE Design, Development, and Testing

The job of creating an executive information system involved two principal tasks: identifying what information is really "executive" in nature and determining how best to deliver it. The Office of Institutional Research was given the task of surveying the administration on the most crucial information needs. Consultations with the senior officers revealed that their needs could be categorized into six areas of interest: Enrollment, Admissions, Development, Finance, Resources, and a News/Facts "catch-all" category. To trim down all the data these areas could encompass, each office with responsibility in these areas was asked to provide what information they thought was basic to describe their area and what they considered important to monitor. The ground rules were simple; the information that they thought to be vital had to be captured on one page. Although initially incredulous at the prospect that their operation could be monitored on one page of information, most reporting offices finally acknowledged that their principal vital signs could be tracked with only a handful of statistics. Reaction from the senior staff and President to proposals for the information models had the effect of summarizing many separate data items even further and indicated the need for an extended, though somewhat different, distribution for each area of information.

After three months of determining needs, attention shifted to the best means for information delivery. A larger and more complex routing was now evident (see Fig. 2) and it was clear that many administrators would not receive the reports for all areas. This fact, combined with a much more limited information base, inspired us to look at the computer screen as a solution to the problem. Enthusiasm was tempered after a month long search failed to reveal any information system packages that were affordable in terms of either software expense or impact on the computer system´s resources. A brief inquiry to our own highly competent computer staff found them challenged by the task but already overextended on current projects. Looking at what software was already available or "off-the-shelf" revealed only DECWORD, DEC´s word processing software, and DREAMS, Dickinson´s own electronic mail software. DECWORD had the composition, format, and screen scrolling features but lacked extensive communication capabilities. DREAMS had extensive communication powers but virtually no screen composition or display features. The other major drawback to DREAMS was its lack of backward screen scrolling which precluded the sending of two or more related screen size pages of information to present one report. This was an important hindrance because a computer screen holds 2,000 characters of information on an 80 column by 25 row matrix whereas a typewritten 8 1/2" X 11" page permits upwards of 3,600 characters depending on font and spacing. Graph paper laid out to identical dimensions of the computer screen characters indicated the need for more data paring and extensive use of abbreviations. After several drafts, the Enrollment Data Screen (see Fig. 3) was ready for composition and uploading. For the tedious task of composing a data screen format, DECWORD was the only solution for offices with only CRT terminal equipment. For offices with microcomputers, spreadsheet software enabled not only quicker formating but provided an opportunity for the incorporation of formulas which would automatically recalculate associated data.

Though by no means an elegant means to compose a data screen, both approaches were tested, documented, and distributed by the Office of Institutional Research to all reporting offices. The Enrollment Data Screen was the first screen to be ready and was sent via electronic mail on March 14, 1986. A standard mail system diagnostic on that date revealed that all PULSE readers had read the screen within two hours with no special advance warning of its delivery. Subsequent diagnostics have revealed that a data screen is read by the authorized readership within an average of two hours and fifteen minutes after transmission. It is now standard practice to release a new data screen at the end of the business day and readers have come to expect this timing.

Accompanying the first data screen and all subsequent screens is a two page users "manual". The first page is always a listing of the most commonly used mail commands and an explanation of their effect. The second page is an explanation of the data screen being viewed. It is prepared as a reproduction of the screen with the borders containing expansions of the abbreviations used, data definitions, and an expected reporting frequency.

Documentation for reporting offices turned out to be a major effort while that performed for readers was minimal. Readers had seen hard copy drafts of the screens so many times that they were completely familar with the location and interpretation of the information. Since all PULSE screen commands are identical to normal mail commands, the usually important aspect of training on a new system was literally a non event.

PULSE in Practice

Perhaps the most telling tribute to the PULSE system´s success is the fact that the officers who report out the data screens have stopped receiving phone calls on any items covered by the data screens. This was certainly not the case when hard copy reports were issued on the same areas of information. Another interesting observation has been that prior to PULSE screens, most errors were caught by the reporting office before they were discovered by readers; now just the opposite is true.

Users report that they often converse with the sender about information on the screens via the action line at the bottom of each screen. Often questions raised are of enough general interest that the reporting officer copies the question and his response back to the entire readership. Readers report that they did not have the time to engage in this kind of dialog when hard copy reports would have necessitated phone calls or in person meetings.

PULSE commands allow the reader to respond to a data screen in many ways. A data screen can be replied to with a request for more information from the sender. A screen often generates the desire for a "party-line" conversation between one recipient and one or more or all readers. The entire authorized readership can be addressed by one password. Screens can be copied to an on-line history file reserved for that particular screen type with a maximum of seven keystrokes. Retrieval of the latest or an older screen takes as little effort. Screens can be also printed off for use in conference room environments. Occasionally, a screen should be sent to a reader who is not normally on the regular distribution list. The priviledge to forward a screen is limited to the President and senior staff.

At certain times of the year, some offices may issue new screens as often as one per day. To quickly identify for the reader what has changed without the need to do a tedious screen to screen comparison, the use of an arrow (>) symbol in front of a new data element was incorporated as a feature of all screen formats. In addition, certain changes in need of special explanation are accommodated by the use of a "remarks" block at the bottom of each screen.

Preliminary Evaluation

With only ten months of experience, it would be premature to state that PULSE screens have an assured place in our decision making process. Currently, they do represent a substantial improvement over our old ways of communicating information. The use of electronic mail, though embraced as a last resort initially, has had an advantage no other commercial information system contained - the positive delivery of new information every time the user reads his mail account. This attribute alone has been so effective that we would incorporate it into any new major revision of the system.

Another unexpected bonus was the electronic mail system's inherent capability to permit PULSE access twenty-four hours a day whether at work or at home and even while traveling away from campus via the use of laptop computers with on board modems. The ability to access the latest information after normal working hours and anywhere there is a telephone is a popular feature.

Two of the major drawbacks of our current system have already been alluded to: lack of multiple page reports and the somewhat awkward updating process. Another drawback is the use of the (>) symbol to flag changes. A better way would be to highlight or "bold" changed items. Nice to have also would be a graphics capability and a menu driven approach to screen access.

Plans for the Future

The three screens now on-line, Admissions, Enrollment, and Development, are soon to be supplemented by three more - Finance, Resources, and a News/Facts Screen. If these screens are evaluated as sucessful, it is likely that we will turn our attention to the development of a menu driven on-line institutional fact book with completely open access to the entire campus community. Such a system would be much more detailed and comprehensive than the current PULSE screens but would be updated only on a semi-annual basis.

Figure 1

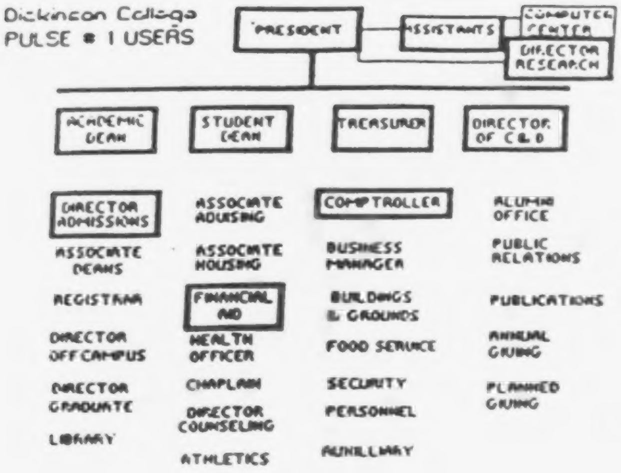

Dickinson College
PULSE # 1 USERS
PRESIDENT
ASSISTANTS
COMPUTER CENTER
DIRECTOR RESEARCH
ACADEMIC DEAN
STUDENT DEAN
TREASURER
DIRECTOR OF C & D
DIRECTOR ADMISSIONS
ASSOCIATE DEANS
REGISTRAR
DIRECTOR OFF CAMPUS
DIRECTOR GRADUATE
LIBRARY
ASSOCIATE ADVISING
ASSOCIATE HOUSING
FINANCIAL AID
HEALTH OFFICER
CHAPLAIN
DIRECTOR COUNSELING
ATHLETICS
COMPTROLLER
BUSINESS MANAGER
BUILDINGS & GROUNDS
FOOD SERVICE
SECURITY
PERSONNEL
AUXILLARY
ALUMNI OFFICE
PUBLIC RELATIONS
PUBLICATIONS
ANNUAL GIVING
PLANNED GIVING

Figure 2

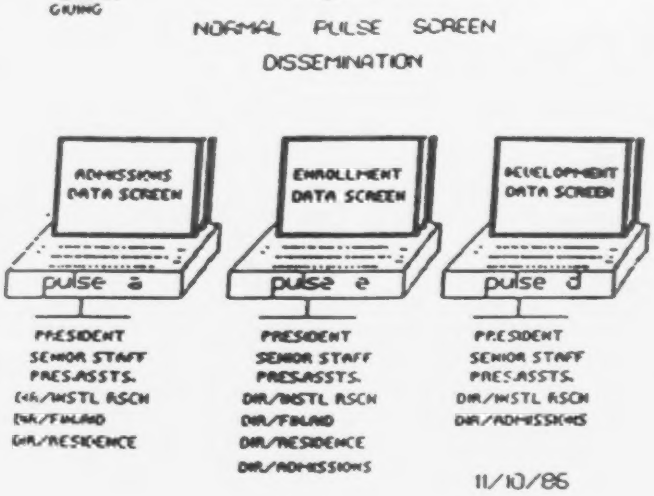
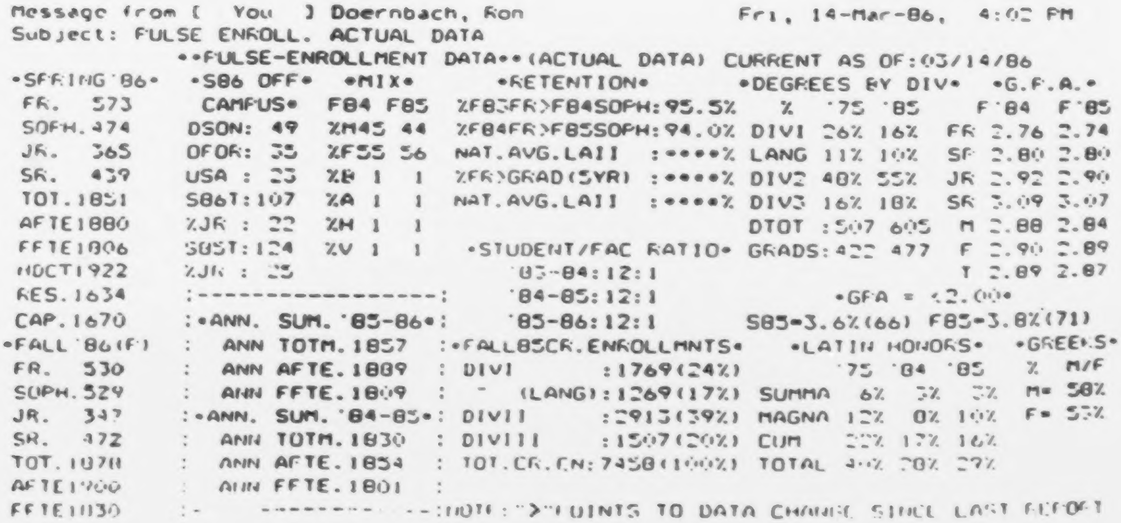

NORMAL PULSE SCREEN
DISSEMINATION
ADMISSIONS DATA SCREEN
pulse a
ENROLLMENT DATA SCREEN
pulse e
DEVELOPMENT DATA SCREEN
pulse d
PRESIDENT
SENIOR STAFF
PRES.ASSTS.
DIR/INSTL RSCH
DIR/FIN.AID
DIR/RESIDENCE
PRESIDENT
SENIOR STAFF
PRES.ASSTS.
DIR/INSTL RSCH
DIR/FIN.AID
DIR/RESIDENCE
DIR/ADMISSIONS
PRESIDENT
SENIOR STAFF
PRES.ASSTS.
DIR/INSTL RSCH
DIR/ADMISSIONS
11/10/86

Figure 3


```
Message from [  You  ] Doernbach, Ron                     Fri, 14-Mar-86,  4:02 PM
Subject: FULSE ENROLL. ACTUAL DATA
          **FULSE-ENROLLMENT DATA**(ACTUAL DATA) CURRENT AS OF:03/14/86
*SPRING'86*  *S86 OFF*  *MIX*     *RETENTION*          *DEGREES BY DIV*  *G.P.A.*
 FR.  573     CAMPUS*  F84 F85  %F83FR>F84SOPH:95.5%   %   '75 '85      F'84  F'85
 SOPH.474    DSON: 49  %M45 44  %F84FR>F85SOPH:94.0% DIV1 26% 16%  FR 2.76 2.74
 JR.  365    OFOR: 35  %F55 56  NAT.AVG.LAII  :****% LANG 11% 10%  SP 2.80 2.80
 SR.  439    USA : 23  %B  1  1 %FR>GRAD(5YR) :****% DIV2 48% 55%  JR 2.92 2.90
 TOT.1851    S86T:107  %A  1  1 NAT.AVG.LAII  :****% DIV3 16% 18%  SR 3.09 3.07
 AFTE1880    %JR : 22  %H  1  1                      DTOT :507 605  M 2.88 2.84
 FFTE1806    SOST:124  %V  1  1   *STUDENT/FAC RATIO* GRADS:422 477  F 2.90 2.89
 HDCT1922    %JR : 25                '83-84:12:1                   T 2.89 2.87
 RES.1634    :------------------:    '84-85:12:1         *GPA = <2.00*
 CAP.1670    :*ANN. SUM.'85-86*:     '85-86:12:1      S85=3.6%(66) F85=3.8%(71)
*FALL'86(F)  :  ANN TOTM.1857  :*FALL85CR.ENROLLMNTS*   *LATIN HONORS*  *GREEKS*
 FR.  530    :  ANN AFTE.1889  : DIVI        :1769(24%)     '75 '84 '85   %  M/F
 SOPH.529    :  ANN FFTE.1809  :  "   (LANG):1269(17%) SUMMA  6%  3%  3%  M= 58%
 JR.  347    :*ANN. SUM.'84-85*: DIVII       :2913(39%) MAGNA 12%  0% 10%  F= 53%
 SR.  472    :  ANN TOTM.1830  : DIVIII      :1507(20%) CUM   22% 17% 16%
 TOT.1078    :  ANN AFTE.1854  : TOT.CR.CN:7458(100%) TOTAL  40% 20% 27%
 AFTE1900    :  ANN FFTE.1801  :
 FFTE1030    :-      ---------- --:NOTE:">"POINTS TO DATA CHANGE SINCE LAST REPORT
```

Data Sharing Among Campuses: Success and Prospects

Daniel A. Updegrove
Vice President
EDUCOM

and

Thomas J. Abdella
Assistant to the Director
Office of Budget and Financial Management
Wellesley College

with the assistance of
John A. Dunn, Jr.
Vice Planning, Planning
Tufts University

ABSTRACT

In the absence of absolute measures of institutional health, colleges and universities often compare themselves with peer institutions, using historical trend data and ratio analyses. One promising approach to peer group data sharing is the Tufts-EDUCOM Data Sharing Project, which now supports over 50 liberal arts colleges and 17 private research universities. More than a "raw" data bank on finances, enrollments, faculty, libraries, and computing, the Project includes carefully-constructed data profiles, built-in ratio analyses, and semi-annual meetings to discuss policy implications, new data comparison areas, and system developments.

This paper will provide an overview of the Project as well as case histories. Implications for other peer group efforts will also be explored.

Data Sharing Among Campuses: Success and Prospects

How healthy is your college or university? You know the budget is balanced, enrollment is declining slowly, the capital campaign seems to be on target, students like the new online library catalog, and your athletic program has avoided scandal for five consecutive years -- but there don't seem to be any absolute indicators of institutional health. Thus, you are led to comparisons with peer colleges or universities, using data collected through telephone surveys and discussions around a bar at the annual conference. Isn't there a better way?

Experience with the Tufts - EDUCOM Data Sharing Project (originally EDUCOM's Higher Education Data Sharing Project, HEDS) indicates that there is a better way, which (not surprisingly) uses computers. Both the data sharing process and applications to institutional research and planning will be surveyed in this paper.

The Process of Data Sharing

The Project is now five years old, and enrolls eighteen universities and fifty colleges as members (Appendix A). Its purpose is to support college and university planning and management by facilitating self-assessment and comparisons with peers, using computerized data-handling and analysis techniques. Now fully supported by membership dues, the Project received three start-up grants from the Exxon Education Foundation, and software support from Lotus Development Corporation.

At heart, the project is a shared institutional database. Each school supplies its own data, generally in the form of copies of national surveys (e.g., HEGIS and IPEDS). The staff at Tufts collates the data from all members and produces reports that, in addition to recapitulating the data, produce a wide variety of trend indicators, ratios, percentages, and graphics of key items. Using a set of national economic, demographic, and higher education data, the figures for individual institutions and the group as a whole can be related to the broader context: financial figures are deflated by Higher Education Price Indices, admissions data tracked as percentages of state high school graduates, and salaries seen in relation to national averages.

The database is intentionally broad. Members contribute data on finances, fund-raising, enrollments, admissions, student charges and financial aid, libraries and computing resources, faculty numbers and salaries, sponsored research, facilities, and personnel.

The Project asks for a minimum of added data collection effort from the members, taking advantage of existing survey efforts wherever possible. Only where good survey don't exist (e.g., degree-completion rates), or where a few additional data elements are needed to complete an understanding, are project-specific surveys undertaken. The added value of the Project comes in a number of ways. Survey results are available more quickly than from the national source. The reports emphasize insight, not data, through extensive use of graphics, ratios, and indicators. The breadth of the database permits multi-dimensional studies and comparisons. A monthly newsletter facilitates communication on relevant issues. Finally, participants meet at least twice yearly to review and discuss results, and to share problems or opportunities they encounter on their individual campuses.

But what about problems of comparability and accuracy? No two institutions are truly alike, and there are inconsistencies in reporting, even with careful data element descriptions. To minimize problems, each survey goes through a two-round production cycle. The first is a quick hard-copy feedback of reported data, ratios, and graphics, to be reviewed by the contributing institutions for accuracy. After any corrections and/or added analyses, a final report is produced both in hard copy and on diskette. The advantage of the diskette output, which uses Lotus 1-2-3 format, is that planners and managers can construct their own peer groups, conduct special analyses, and produce their own graphics.

Applications

The first question that arises in "peer group" data sharing is, which institutions form the relevant peer group? Although there are many familiar peer groups, such as the Big Ten (but Northwestern is private) and the Ivy League (but Cornell is part state-supported) and a growing number of less familiar ones (like "The Dirty Dozen" and "The Six Pack"), many analysts would argue that the definition of the peer group changes with the problem being addressed. That is, for a study of student financial aid, Wellesley College might be interested in policies at MIT, whereas it would probably not include MIT in a study of campus computing expenditures.

One approach to defining a relevant peer group is shown in Appendix B. In this graph enrollment is plotted against expenditures per student (educational and General expenditures plus mandatory transfers), which indicates other institutions that are of a similar size and wealth. (Campuses are coded here to maintain the confidentiality of the data.) A related measure, especially relevant for private institutions is shown in Appendix C, wherein enrollment is graphed against endowment market value per student. Thus one of the first payoffs of data sharing is gaining a better definition of an institution's peer group. Then, what?

The distinction among operational, tactical, and strategic decisions is a crude but useful one. Within an institution, operational decisions are made on a daily basis and involve routine activities. They require information systems with a high degree of specificity, timeliness and accuracy. The bursar must know at any point in time who has paid tuition and how much. Tactical decisions are more complex. They tend to require more aggregated information, are more apt to have a future orientation, and often require data from outside the institution. The chief business officer's selection of a different mix of tuition payment plans would be an example.

Finally, strategic decisions are infrequent and imprecise, involve longer-range policy, and are often based on impressions rather than hard data because relevant data cannot be gathered. These decisions usually require more understanding of the context in which the institution is operating than of specific data from within it. The President's tuition pricing and financial aid strategy, for instance, is related to the mission of the institution, to the competitive marketplace, to judgements about tradeoffs between increased charges and program improvements, and the like. It is in the area of strategic and tactical decisions that comparative data can be most useful, by providing clearer understanding of the context in which the institution is operating.

Examples may be helpful. Wesleyan University in Connecticut has described itself for a number of years as a "little university," and has worked to develop a selected number of research and graduate education programs. While administrators had known for some time that their tuition pricing placed them a bit above most selective private colleges and a bit below the leading private research universities, they were reassured to see from an analysis of expenditure patterns that their sponsored research activity fell in the same area.

At Tufts University, a great deal of effort has gone into fund-raising in the last several years, culminating in the recent successful conclusion of a major capital campaign. Using both national Committee for Financial Aid to Education (CFAE) data and information from the Tufts - EDUCOM Data Sharing Project institutions, the planning office has carefully tracked annual performance on a variety of indicators. At the operational level -- e.g., for soliciting specific prospects -- this information is unhelpful. In budget planning (a tactical process), they have learned that it costs a good deal more per dollar raised than most successful competitors, and have begun to focus expenditures more carefully. At the strategic level, however, given the magnitude of support and the budget leverage being won by peer institutions, it is clear to Tufts that continued aggressive fund-raising, even at substantial expense, is essential.

Several features of this application should be noted. First, operational data on gifts or expenses for one institution, when shared with or compared with similar data from others, yield useful insights for tactical and strategic planning. Second, indicators are much more useful than raw numbers. Percent of alumni/ae contributing, ratio of support from individuals to support from organizations, proportion of support from alumni/ae (versus from unrelated individuals), relative dependence on large gifts, and ratio of expenditures or personnel to fundraising results in each area -- these and similar ratios looked at over time are more meaningful than the raw data on which they are based. Third, despite the presence of a fairly comprehensive and extremely helpful national survey, collaboration among a group of similar universities to exchange additional data agreed on collectively was essential to the usefulness of the outcome.

For further information

The project staff at Tufts consists of John A. Dunn, Jr., Jennifer Mauldin, Audrey Adam, and Kate Hill. They work under the guidance of a project advisory committee consisting of nine representatives, four each elected by the university and college members, as well as Daniel A. Updegrove of EDUCOM.

Membership in the Project is by consent of the present members. Interested selective private colleges and universities are invited to inquire. In addition, the Project staff would be interested in talking to and possibly providing support for persons from other types of institutions (e.g., technologically oriented universities, public universities) who are considering forming peer groups. Contact should be with John A. Dunn,Jr., Vice President for Planning, Tufts Univesity, Medford, MA 02155. Telephone 617-381-3274.

References

Portions of this paper are drawn from J. A. Dunn's "Seeing yourself in Context: The Tufts - EDUCOM Data Sharing Project," submitted to EDUTECH Report for publication in early spring, 1987.

E.F. Cheit, The New Depression in Higher Education (New York: McGraw-Hill, 1971), and A. H. Lupton, J. Augenblick, and J. Heyison, "The Financial Status of Higher Education," Change September 1976 (pp. 21-35) are pioneering works on financial health of colleges and universities.

N. Dickmeyer and K. S. Hughes, Financial Self-Assessment: A Workbook for Colleges (Washington: NACUBO, 1980) is the widely used tool and reference work that provided the substantive starting point for the Data Sharing Project. NACUBO plans to publish an update in 1987.

W. F. Massy and D. S. P. Hopkins, Planning Models for Colleges and Universities (Palo Alto: Stanford University Press, 1981), and S. D. Bloomfield and D. A. Updegrove, "Modeling for Insight, Not Numbers," in New Directions for Higher Education: Applying Management Science to Academic Administration (SF: Jossey-Bass, 1981) argue that the learning and insight gained from model building and application are at least as important as results from the models.

Charles H. Warlick (ed), 1986 Directory of Computing Facilities in Higher Education (Austin: The University of Texas at Austin, 1986) is a remarkably comprehensive and current compendium of useful information on academic computing facilities and expenditures. The directory is published annually under the auspices of the Seminars for Academic Computing.

Appendix A

Peer Groups participating in Tufts - EDUCOM Data Sharing Project

Private Research Universities

Brandeis University
Carnegie Mellon University
Cornell University
Duke University

Emory University
Georgetown University
Lehigh University
Mercer University

University of Miami
New York University
University of Pennsylvania
University of Rochester

Southern Methodist University
Tufts University
Tulane University
Vanderbilt University

Washington University

Liberal Arts Colleges

Allegheny College
Amherst College
Barnard College
Bates College
Bowdoin College
Bryn Mawr College
Bucknell University

Carleton College
Claremont McKenna College
Clark University
Colgate University
College of Wooster
Colorado College
Connecticut College

Davidson College
Dickinson College
Franklin and Marshall College
Gettysburg College
Grinnell College
Hamilton College
Haverford College
Harvey Mudd College

Kalamazoo College
Kenyon College
Lafayette College

Lawrence College
Lewis and Clark University
Macalester College
Middlebury College
Mills College
Mount Holyoke College
Muhlenberg College

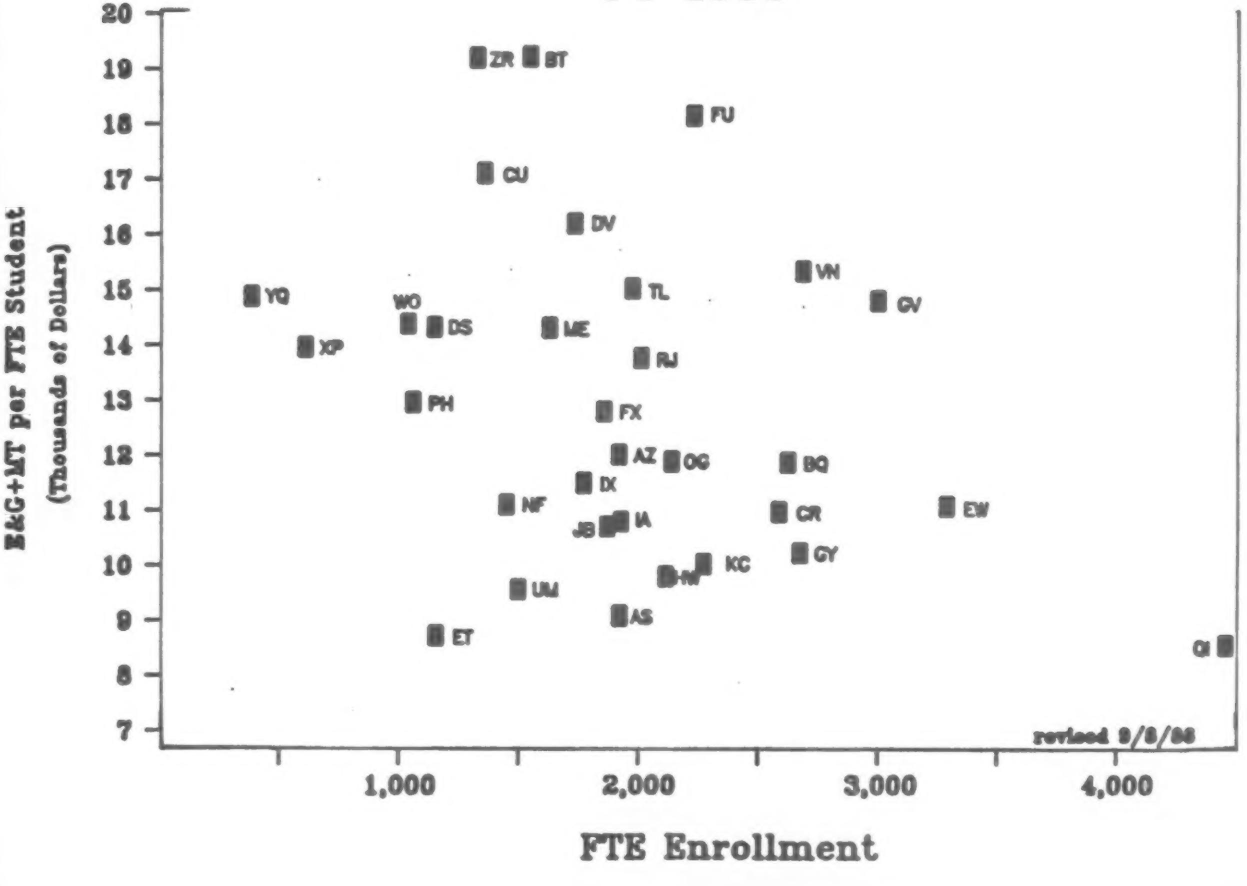
Oberlin College
PomonaCollege
Reed College
St. John's College
Scripps College
Smith College
Swarthmore College

Trinity College
Trinity University
Union College
University of the South
Ursinus College
Wellesley College
Wesleyan College
Wheaton College

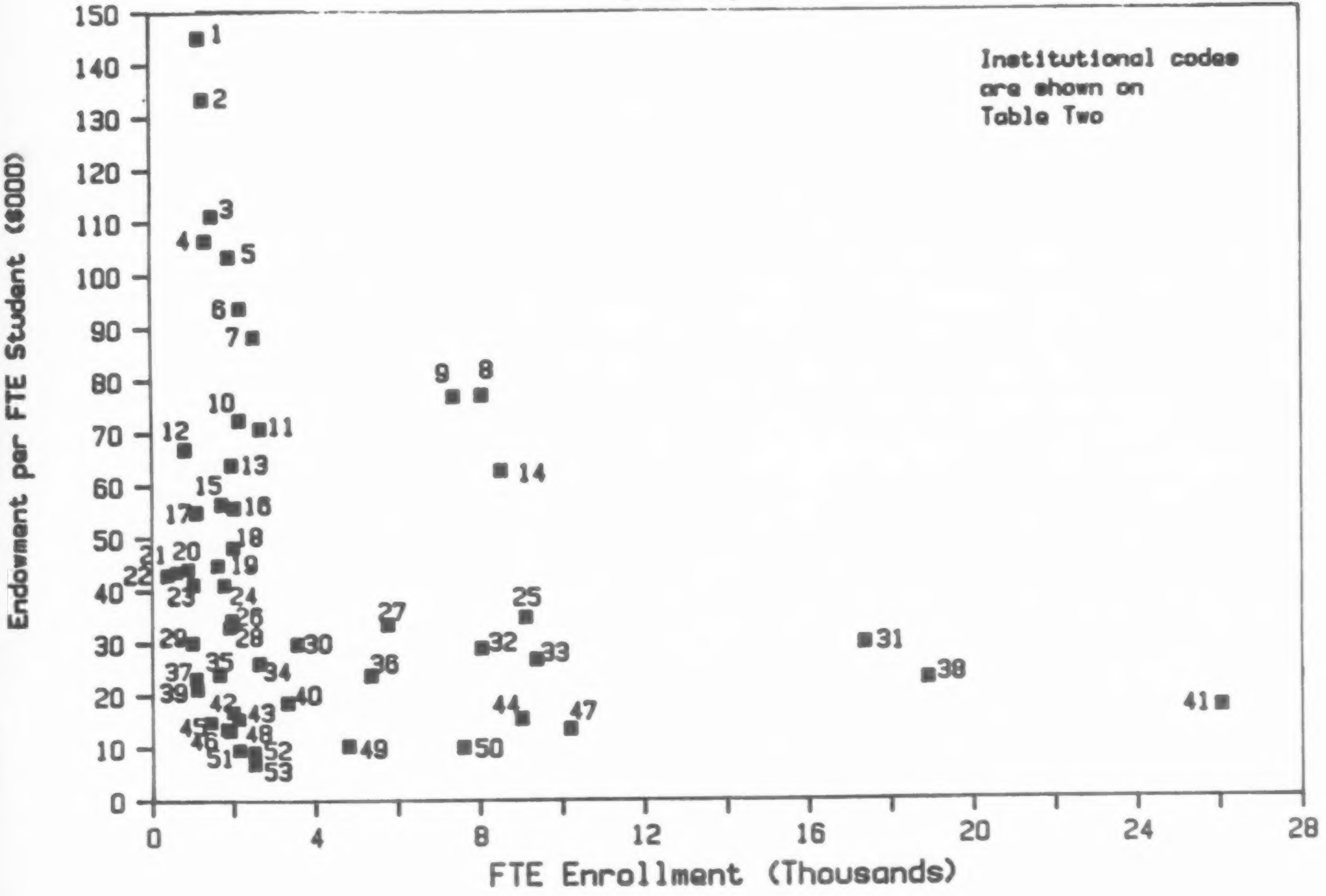
Williams College
Wittenberg College
College of Wooster

~ ~ ~ ~ ~ ~

E&G+MT per Student by FTE Enrollment
FY 1985



Appendix B



Enrollment, and Endowment per Student

June 30, 1985

Institutional codes are shown on Table Two

PLANNING WITH TECHNOLOGY - LRISP III ON TIME WITHIN PHASE AND BUDGET

Paul Costello
M. Lewis Temares
University of Miami
Coral Gables
Florida

University of Miami is midway through its seven year Long Range Information Systems Plan (LRISP). LRISP has spawned a cycle of planning and implementation efforts, as well as annual updates to the Board of Trustees. These planning efforts have been especially challenging. This paper discusses ongoing planning efforts and how technology, in the form of personal computers, word processing and spreadsheet software, and networking have been utilized. The LRISP implementation began in January 1984 with a total project cost estimate of $13.68 million. This was revised to $15.2 million in fall 1984. Since then, the plan has been updated twice (fall 1985 and fall 1986).

INTRODUCTION

The University of Miami, a private, independent, nonsectarian university was chartered in 1925 as a nonprofit institution of learning, whose policies are established by a self-perpetuating Board of Trustees. The University serves approximately 15,000 credit and non-credit students each year. The Information Resources organization supplies information systems, telecommunications, planning, and institutional research services as needed by the university to support its institutional objectives.

In 1983, the information systems organization was so burdened with maintaining old, poorly documented, batch systems, it could not make sufficient headway towards new systems implementation. Clamoring for new systems was relentless but, the ability to deliver was constrained. In an unorthodox move, the University suspended all new systems development activities for four months, in order to put together a Long Range Information Systems Plan (LRISP). Two teams were formed; one team of senior personnel was assigned to develop the plan, while another team was devoted to reducing backlogged maintenance work. In a period of four months, a plan consisting of approximately 250 pages and containing six major strategies for the future of information systems at the University of Miami was approved by the Board of Trustees.

IMPLEMENTATION TO DATE

This year marks the midpoint of this plan's implementation. During the last year, the overall LRISP implementation time table has been reduced by seven months and for the third consecutive year estimated total LRISP project implementation costs continue at $15.2 million. This ambitious project presented the following major challenges during the past year: continuing to control implementation costs, overcoming the experience curve for new software development tools, working within the dynamics of the organization and, limiting employee turnover. These required considerable adaptability affecting the University community as well as the information systems department.

There were many notable achievements during the year. Two major database application systems were implemented (Accounts Receivable and Student Records). Projects were combined, in consultation with project sponsors, resulting in an estimated one-half year reduction of the seven year plan. The Project Definition and Planning (PDP) phase was completed for two projects (Human Resources and Purchasing/Accounts Payable). Completion of the Preliminary Systems Design (PSD) phase for these two projects is expected by the end of December. A reorganization was effected, combining database and applications development staffs, under one director. An IBM 3081 was installed, providing sufficient computing capacity to meet projected needs for the next 24 months. Last, but not least, we began a major systems conversion from our UNIVAC 1100/82 to the IBM 3081 in anticipation of a May 30, 1988 departure of the UNIVAC computer.

This year the two projects successfully completed, Student Records (late) and Accounts Receivable (on-time), were delivered in time to be used for the

Fall, 1986 semester. These important new applications have not only put information at the fingertips of the University's knowledge workers but, they constitute the initial integration of database information for virtually all subsequent applications such as Enrollment Management. Additionally, the purchase of software packages is allowing us to aggregate planned projects in a more functional manner. This results in a planned reduction of one-half year of implementation time from the plan's horizon. Attachment A shows an implementation overview of project activity.

With implementation of foundation systems, overcoming the learning curve and reorganization, our momentum is increasing. During calendar 1987, we intend to implement Recruitment/Admissions, Development/University Relations, the Housing portion of Enrollment Management, and step I (convert to on-line) of Financial Reporting.

Microcomputer usage continues to grow. Training users involved in systems installation includes courses in WordPerfect (a microcomputer wordprocessing package), Lotus 1-2-3 (a microcomputer spreadsheet package) and dBase III (a microcomputer database package). These classes are assisting us and the University community become more proficient in the use of computers.

Implementation of Phase One of the academic and administrative hardware plan approved by the Board (in March 1986) has been completed. We expect a continued increase in demand for hardware resources because of new LRISP application installations, end-user computing, and widening access to the central facility environment. Hardware upgrades to central facility resources, as anticipated in our Hardware Plan, are scheduled with the installation of additional disk drives (December, 1986), additional tape drives (June, 1987) and upgrading of disk drives (June, 1989). Funds for these upgrades have been allocated.

New tools have been acquired in order to monitor and gather pertinent hardware and software performance data. These tools enhance our ability to tune systems effectively.

LRISP pointed out the necessity for implementing certain Local Area Networking (LAN) strategies for inter and intra-campus data communications. While not as a part of, nor funded by LRISP, it is important to note our Coral Gables (main) Campus LAN (UNET) is now a reality. A backbone connecting all Coral Gables campus buildings has been installed and is presently available for student, academic, and administrative use. This network enables wider access to our IBM, UNIVAC, Digital and AT&T host computers. In addition, intra-building networks are being evaluated for standardization to permit departments to share resources.

Important organizational support has been obtained from our:

o Computer Advisory Committee (CAC). This committee, chaired by the Dean of the College of Engineering, continues to oversee LRISP issues as well as other academic and administrative computing issues. It has addressed project scope and priority issues and approved a series of computer policy statements.

- Systems Coordinating Committee (SCC). This committee consists of project steering chairpersons, Chairman of CAC, Provost's representative and Vice President for Business and Finance. Meeting monthly, the committee helps coordinate LRISP issues.

- Project Steering Committees. Each project has a steering committee consisting of faculty and key management users of the particular system. They provide input, oversight, validation, and consensus building for the projects.

- Information Analysts. The assignment of experienced University of Miami personnel with user department experience has proven even more beneficial to proper system development than anticipated.

- Consultants. As recommended by our Board of Trustees, consultants have provided quality assurance and project monitoring services.

There is some bad news (we prefer to say there are challenges) as well. Certain critical, vendor supplied, end-user and central facility software, designed to facilitate access and other end-user computing functions, has failed to meet expectations. "Hands on" experience has highlighted the propensity for this kind of software to consume high levels of resources and to be potentially cumbersome and/or error prone. Vendor resolution of these difficulties, while being addressed, is a year or more away.

In the interim, necessary guidelines defining appropriate use of these software products are being drafted. Use of these products will therefore be somewhat limited during the coming year. A search is underway to determine if other products are available that would serve us better.

Resignation of the Director for Applications Development, while causing some disruption, resulted in an opportunity. Management of database and applications development staffs was combined under one director, thereby increasing coordination and reducing conflict. Retention of qualified persons in the positions addressed by LRISP continues to be a challenge. Staff development and career enhancement programs (including video taped and computer based training courses) seem helpful in keeping turnover at approximately 20 percent.

USING TECHNOLOGY

Personal computers, wordprocessing and spreadsheet software, as well as an intra-departmental network have been critical success factors for our ability to sustain the LRISP implementation (with its annual updates to the Board of Trustees), develop a hardware plan, and contain both regular operating costs and the LRISP implementation within budget.

We have migrated from Display Writers and early off-brand microcomputers (we bought two ACCESS microcomputers) through IBM PC compatibles (two portable Columbias) to IBM PC XTs and Leading Edge PC XT compatibles. Both the ACCESS' and the Columbias came with wordprocessing (Perfect Writer) and spreadsheet (Perfect Calc) software. While these easily met our initial needs, we now use

Word Perfect (for all our wordprocessing), Lotus (for all our spreadsheets and all but presentation graphs), and LISA Draw for presentation graphics.

Our business office support unit (six PC XTs, including departmental secretarial support) is networked with 3-Com Ethernet. This allows for file sharing and multi-station use of shared print facilities. This intra-department network is a test installation. We are still evaluating other network solutions (for instance IBM's Token Ring, and Ungarmann-Bass' UNET).

We use spreadsheets to plan, budget, monitor, and control costs for regular operations and LRISP implementations. This allows us to understand, report, and control LRISP application development costs at both individual project and total levels as well as by broad category of expense (Personnel, Software - including miscellaneous, Hardware, and Prorated).

PLANNING AND BUDGETING

Each year LRISP implementation costs and benefits are recast by individual project. This starts with two rounds of consultation sessions with project sponsors. The scope and viability (continuing need and/or benefit) of each project is reconfirmed and updated. The first round concentrates on the continued need to do already defined projects and sensing the need for new ones as well as confirming the scope of each project. The second round concentrates on measurable benefits. These are noted (relative to project implementation date) in a spreadsheet as they are confirmed.

Following the first round of sponsor consultations, information systems management, including project managers for ongoing projects, translates first round results into a Gantt chart listing each project. Completed projects are well known, concrete entities on the chart. Ongoing projects are relatively well known entities, but ones that introduce some uncertainty. Least well known and accordingly only crudely sized are future projects. Naturally these contain the most risk and uncertainty.

The Gantt chart, portraying each project's duration, is now used as a tool to help budget total LRISP implementation costs in four broad cost catagories (Personnel, Software - including miscellaneous, Hardware, and Prorated). A separate spreadsheet is prepared for each cost category.

Since a specific personnel pool is dedicated to the LRISP implementation, this cost is perhaps the most easily budgeted. First an assumption is made (it is invalid for close monitoring of individual project costs but works fine for the broad scale of estimating required at this point) that each project's personnel costs for a unit of time (a month) will be the same. That is, in any given month during a project's life, a project will use its pro-rata share (one sixth for six concurrent projects) of pooled personnel resources.

Total personnel cost for the upcoming year is budgeted on a line by line basis, one line for each authorized position (without respect to projects). The effect of a planned for merit salary pool distribution is accommodated. Salary amounts for Project Managers, Systems Analysts, Information Analysts, Data Base Analysts, Programmer Analysts, Secretarial Support, and College Work

Study Aides are all listed in a "next year's budget" format. This spreadsheet's total is entered in the project total personnel spreadsheet for the upcoming and for each successive full year. The last, partial year, has a prorated amount entered based upon the number of "project months". A full year consists of 6 projects active for 12 months, or 72 "project months".

Next a project total personnel cost spreadsheet is prepared. Projects are listed vertically (rows). Fiscal years are listed horizontally (columns) with two columns devoted to each year. The first column for each year is filled in with the duration (in months) a particular project will be active (obtained from the Gantt chart). The year's total personnel budget is filled in (at the top of the remaining column). Actual (booked) personnel expense is filled in for each project for past years. Personnel expense for future years, is prorated among active projects for each fiscal year. For six concurrent projects the formula is simply the total year's personnel expense divided by 72 (6 concurrent projects for 12 months) and then multiplied by the planned duration (in months) for each project during the year.

Similarly, a spreadsheet set is prepared for project total prorated costs. Prorated costs are the common costs (exclusive of personnel) shared equally by projects during their active life. These include, but are not necessarily limited to: space rent; telephone and data line service; consulting support; equipment maintenance costs for terminals, printers, PCs, PC software, and mainframe software used only by the development group; as well as certain start up costs (for instance the acquisition cost of furniture, terminals, printers, micro-computers, etc.).

Two additional spreadsheets are now prepared, one for project total hardware costs, and one for project total software costs. Just as with the two previous spreadsheets, actual costs to date through the end of the current fiscal year are entered first. Individual project software costs are then estimated based upon decisions and/or expectations to purchase package software. Amounts are entered for the remaining projects based on size (small, medium, or large). Individual project hardware costs are estimated in a similar manner.

LRISP project hardware costs fund terminal access only. Only a minimal, required level of access is so funded. With few exceptions LRISP projects have paid only the acquisition cost of terminals (or an equal amount towards the acquisition of approved plug compatible replacement equipment, for instance a PC equipped with an Irma card). Installation and recurring costs for data circuits as well as acquisition and recurring maintenance costs for remote terminal controllers are funded by the central facility.

These four spreadsheets (LRISP Total: Personnel, Software, Hardware, and Prorated costs) are now "rolled into" three different project total cost spreadsheets as follows:

- o Project Total Cost by Category. This lists each project vertically, and the four cost catagories (and project total) horizontally.
- o Application Development (Project) Total Cost by Fiscal Year. This

lists each project vertically, and the project total for each fiscal year horizontally.

Project Total Amortization Cost by Fiscal Year. This lists each project vertically. Project total cost as well as 14 fiscal years are listed horizontally. The total for each project is then amortized over 7 years (84 months) beginning the month following the scheduled project implementation. Naturally, each fiscal year is totaled.

Concurrent with the budgeting effort above, a second round of consultations with user sponsors is being held. This round concentrates on identifying measurable benefits (reduced costs and/or increased revenues) attributable to individual projects. These benefits are summarized by fiscal year for each project. In this process individual projects are listed vertically, and fiscal years are listed horizontally. A final budget schedule is now prepared (by the budget office, from the amortization and benefit schedules) showing net cost or benefit by university budget unit (college, school, department and or administrative unit) for each fiscal year as well as total university by fiscal year.

MONITORING AND CONTROLLING

Each month project costs are extracted from the financial reporting system and entered in a set of monitoring spreadsheets. Project costs are examined at a detail level and summarized by each of the four cost catagories used in the budgeting process. Summary schedules are prepared for each fiscal year listing monthly costs, by cost category for each project as well as annual schedules showing actual cost by cost category within project.

During each of the first two (PDP and PSD) phases of a project there are attempts, on the basis of more detailed information about the work to be performed, to more accurately forecast project costs using the same four cost catagories. At the end of each of these first two phases, a management report is prepared (including a more detailed analysis of both costs and expected benefits) and submitted to the project steering committee and senior level university management. Since project steering committees are composed of those who will bear the project amortization expense for the seven years following system implementation, a reasoned and conscious management decision to continue or to abandon the project is made at both of these bench marks.

We look foreword to implementing our new Financial Reporting System and resolving certain end-user software challenges. Our intent is to automate the down loading of departmental financial data. Ideally, the data will be loaded into a dBase 111 file or files, and from there into Lotus spreadsheets. This will eliminate approximately two to three person days (now accomplished by a senior in the Honors Program) of data entry and screening immediately following monthly financial report publication. However, the discipline forced by our current need for manual data entry has been constructive.

Attachments B and C are examples of a LRISP spreadsheet and report.

LESSONS

We have frequently found it necessary and/or appropriate to adjust an initially prepared planning and budgeting spreadsheet. For instance, the expense impact to various university organizational units could be significant if a project was delivered ahead of schedule. Accordingly, we usually prepare two amortization schedules, one matching the Gantt chart, and one showing the impact of earlier installation dates for appropriate projects. The budget office is then able to better understand and plan for the variability inherent in our development efforts.

We have found personnel costs and prorated costs to be the ones that require the most careful monitoring. These costs are effectively regular "burn rates", operating as a function of time and resources in place. Additionally, these account for the bulk ($12.2 million) of our estimated $15.2 million total cost. Accordingly, much attention (on a recurring monthly basis) is devoted to confirming these costs are held at or below budget levels and these resources are being effectively used.

Software and hardware costs are controlled at specific points in the project life cycle. Typically, it is important to confirm initial scope of these costs as early in the PDP phase as practical, and to actively attempt to contain them at planned levels during appropriate points of the PSD phase.

SUMMARY

The creation of a Long Range Information Systems Plan forms the basis of a common goal for the organization, describing a future state of affairs. It channels day-to-day decisions towards realization of that future environment, rather than leaving the future to happenstance. Planning is not an activity performed in isolation, but is best served by participation of those seeking to bring it to fruition.

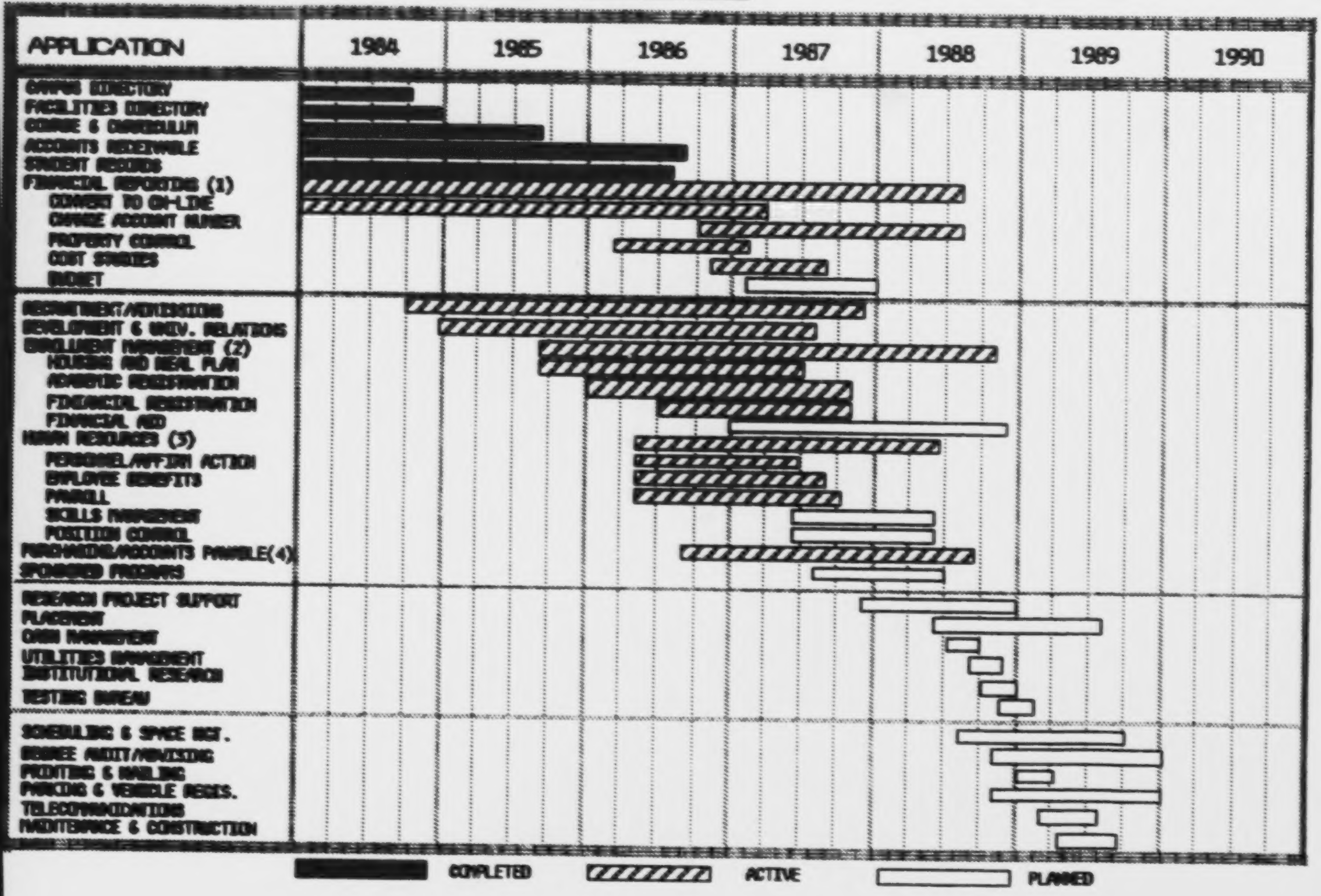
In order to succeed, we must pay more attention to information systems management. Unfulfilled plans are legion, having been relegated to the shelves of good intentions. A working plan must be dynamic, but not capricious. It should be molded by reasonable adjustments, based on the wisdom gained from experience.

Spreadsheets allow us to quickly respond to changing needs and to report at varying levels of detail, or granularity, to our different constituencies (Project Managers, Information Resources Management, Steering Committees, Computer Advisory Committee, Board of Trustees, Senior University Officers, Faculty and Administration groups.

The Information Resources organization will continue to change in response to changing technology and increasing demands from a more "computer intimate" university community. During 1986, increased emphasis has been placed on the integration of applications development and database management as well as project cost controls. The introduction of new systems significantly affects the way the University community does its business. Training, coaching and advising are new roles we are seriously addressing.

LRISP IMPLEMENTATION DETAIL

OCTOBER, 1986



ATTACHMENT A

ATTACHMENT B

LRISP IMPLEMENTATION TOTAL COST BY PROJECT
AT 1986/87 RATES
OCTOBER 1986

PROJECT	ORIGINAL BUDGET		EXPENSE EXPECTED THRU 8/31/86		EXPENSE FORECAST 9/86-END		FORECAST TOTAL @10/86	
CAMPUS DIRECTORY	395,906		474,413				474,413	
FACILITIES DIRECTORY	262,213		297,369				297,369	
COURSE & CURRICULUM	476,760		567,850				567,850	
ACCOUNTS RECEIVABLE	664,761		1,037,901				1,037,901	
STUDENT RECORDS	430,760		868,767				868,767	
PROJECTS DELETED 1984/85	889,528							
SUBTOTAL COMPLETED/DELETED		3,119,928		3,246,300				3,246,300
FINANCIAL REPORTING	1,951,577		1,087,006		1,064,096		2,151,102	
RECRUITMENT/ADMISSIONS	654,519		649,914		550,549		1,200,463	
DEVELOPMENT & UNIV. RELATIONS	760,162		606,703		536,510		1,143,213	
ENROLLMENT MANAGEMENT	1,263,588		451,393		1,032,009		1,483,402	
HUMAN RESOURCES	1,550,092		339,317		757,729		1,097,046	
PURCHASING/ACCOUNTS PAYABLE	966,035		35,110		884,462		919,572	
SUBTOTAL IN PROCESS		7,145,973		3,169,442		4,825,356		7,994,798
SPONSORED PROGRAMS	411,196		15,055		458,977		474,032	
RESEARCH PROJECT SUPPORT	239,166		15,055		431,426		446,481	
PLACEMENT	239,166		15,055		463,792		478,847	
HEALTH SERVICES	16,293							
CASH MANAGEMENT	211,198		15,055		168,501		183,556	
LIBRARY	16,293							
UTILITIES MANAGEMENT	239,166		15,055		143,436		158,491	
INSTITUTIONAL RESEARCH	239,166		15,055		143,435		158,490	
TESTING BUREAU	239,166		15,055		143,435		158,490	
SCHEDULING & SPACE MANAGEMENT	239,166		15,055		528,077		543,132	
DEGREE AUDIT/ADVISING	239,166		15,055		543,993		559,048	
PRINTING & MAILING	239,166		15,055		143,435		158,490	
BOOKSTORE	16,293							
PARKING & VEHICLE REGISTRATION	239,166		15,055		193,993		209,048	
TELECOMMUNICATIONS	239,166		15,055		201,919		216,974	
MAINTENANCE & CONSTRUCTION	239,166		15,055		202,768		217,823	
SUBTOTAL		3,302,099		195,715		3,767,187		3,962,902
TOTAL		13,568,000		6,611,457		8,592,543		15,204,000

ATTACHMENT C

PROJECT TOTAL COSTS 1986/87

	PROJECT	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	TOTAL
1	CAMPUS DIRECTORY	271,397	189,792	2,224	0	0	0	11,000	0	474,413
2	FACILITIES DIRECTORY	76,838	207,307	2,224	0	0	0	11,000	0	297,369
3	COURSE & CURRICULUM	66,159	377,106	113,585	0	0	0	11,000	0	567,850
4	ACCOUNTS RECEIVABLE	82,561	345,309	463,016	136,015	0	0	11,000	0	1,037,901
5	STUDENT RECORDS	80,507	397,751	312,703	66,806	0	0	11,000	0	868,767
6	FINANCIAL REPORTING	119,875	400,580	533,848	653,461	362,159	62,175	11,000	0	2,151,102
7	RECRUITMENT/ADMISSIONS	5,606	156,463	388,150	456,328	182,915	0	11,000	0	1,200,462
8	DEVELOPMENT & UNIV. RELATIONS	5,606	159,139	342,263	561,782	63,422	0	11,000	0	1,143,213
9	ENROLLMENT MANAGEMENT	16,818	21,675	178,205	743,626	329,928	182,149	11,000	0	1,483,401
10	HUMAN RESOURCES	28,030	36,125	40,467	579,269	394,381	0	18,774	0	1,097,047
11	PURCHASING AND ACCOUNTS PAYABLE	11,212	14,450	9,448	401,097	380,941	91,424	11,000	0	919,573
12	SPONSORED PROGRAMS	5,606	7,225	2,224	0	365,051	73,207	20,718	0	474,032
13	RESEARCH PROJECT SUPPORT	5,606	7,225	2,224	0	220,502	190,205	20,718	0	446,480
14	PLACEMENT	5,606	7,225	2,224	0	0	383,682	80,110	0	478,847
15	CASH MANAGEMENT	5,606	7,225	2,224	0	0	155,168	13,332	0	183,556
16	UTILITIES MANAGEMENT	5,606	7,225	2,224	0	0	130,103	13,332	0	158,490
17	INSTITUTIONAL RESEARCH	5,606	7,225	2,224	0	0	130,103	13,332	0	158,490
18	TESTING BUREAU	5,606	7,225	2,224	0	0	130,103	13,332	0	158,490
19	SCHEDULING & SPACE MANAGEMENT	5,606	7,225	2,224	0	0	357,131	170,946	0	543,133
20	DEGREE AUDIT/ADVISING	5,606	7,225	2,224	0	0	236,050	307,943	0	559,048
21	PRINTING & MAILING	5,606	7,225	2,224	0	0	130,103	13,332	0	158,490
22	PARKING & VEHICLE REGISTRATION	5,606	7,225	2,224	0	0	45,741	148,252	0	209,048
23	TELECOMMUNICATIONS	5,606	7,225	2,224	0	0	120,435	80,110	0	215,600
24	MAINTENANCE & CONSTRUCTION	5,606	7,225	2,224	0	0	84,428	118,339	0	217,823
	Subtotal	837,499	2,407,627	2,415,042	3,598,384	2,299,295	2,502,207	1,142,572	0	15,202,624
	Reconciling amount									1,376
	TOTAL	837,499	2,407,627	2,415,042	3,598,384	2,299,295	2,502,207	1,142,572	0	15,204,000

Track III

People Issues in Information Technology

In an era of converging information technologies, people are a critical resource. Issues which affect members of the campus community—such as management, training, organizational concerns, the role of end-user computing and personal computing—are covered in this track.

Coordinator:
Floyd R. Crosby
West Virginia University

Donald Hardcastle
Baylor University

Daniel Updegrove, EDUCOM, and
Thomas Abdella, Wellesley College

Anne Woodsworth
University of Pittsburgh

THE STAFFING PROCESS: SELECTION, MANAGEMENT, DEVELOPMENT, RESULTS

Donald L. Hardcastle
Baylor University
Waco, Texas

The staffing process of the 1970's resulted in a mixture of experience, potential and training not capable of meeting the demands of the 1980's. A new process was initiated which is resulting in a staff that has the breadth and depth needed to meet the challenges that the present and future information technologies demand. This process which is basically a "grow your own" process is presented. Critical components discussed include: employment of students, interview, selection, management and development. It is anticipated that by 1990 the goal of having a mature staff capable of meeting the new challenges of the 1990's will have been accomplished.

THE STAFFING PROCESS:
SELECTION, MANAGEMENT, DEVELOPMENT, RESULTS

Many of us face difficult situations. The administration believes the computer salesmen and the ads that appear on television produced by computer vendors. They want today's questions answered with tomorrow's techniques and the results delivered yesterday. The faculty does not understand why the computer center cannot solve the parking problem, the alumni blame the computer for their bad football tickets and the students blame it for their not having a date on Friday night. Our requests for adequate funding levels and staff positions seem to fall on deaf ears. We are told that past funding increases have not produced corresponding results.

We have followed the conventional management methods developed for average companies doing business under normal circumstances. These have not produced the desired results. In order to effectively address these problems we must try new techniques which will require new and creative thinking by our staff. We must then have a creative, resourceful and productive staff.

Introduction

Baylor University is a private, church-related university, owned and operated by the Baptist General Convention of Texas, with an enrollment of 11,000 students. Emphasis is placed on teaching and a liberal arts education. It is composed of a College of Arts and Sciences, and Schools of Business, Education, Music, Nursing, Law and Graduate Studies. Our Law School graduates consistently surpass those from other schools on the state bar exam, our debate team regularly wins the national championship, and our football team this year is regarded nationally as the best team with three losses (of one, three and six points). Ten percent of our students are in graduate programs including doctoral programs in Chemistry, Physics, Psychology, Religion, English and Education.

The Computation Center supports all administrative computing areas on campus and all academic areas except the School of Business. It is composed of four sections: Administrative, Academic, Office Automation and Communications. These sections are housed together and there is a considerable amount of interaction between their personnel.

Over 400 terminals and 300 microcomputers have access to the central computer Micom switch that allows access to an IBM 4381, Honeywell DPS 8/49, VAX 11/785 and VAX 11/780. The Center operates five faculty centers, four student Macintosh labs, two DEC Rainbow 100 labs, one Apple II lab and five terminal centers. The School of Business has an IBM 4361 and several IBM-PC labs.

The computing developments to date have resulted from the initiative and efforts of a few individuals, not from any master plan or planning group. Our philosophy of operation in recent years has been to anticipate the needs of our clients and have acceptable solutions available by the time they recognize their needs.

We now basically follow the idea suggested by Peters and Waterman, "'Doing Things' (lots of experiments, tries) leads to rapid and effective learning, adaptation, diffusion, and commitment; it is the hallmark of the well-run company. Moreover, our excellent companies appear to do their way into strategies, not vice versa."[1]

This paper deals with our development from 1980 to the present and our concentrating on the staffing process. During this time we have installed all new computer hardware, added considerable software and have had a large turnover in staff.

The Need for Change

In 1980 when I took on my present responsibilities we had too few staff; several did not possess college degrees; only one person in the Center had an advanced degree; and we were unable to attract any of our own Baylor graduates.

In reviewing our situation it was quite clear that the present staff was not only incapable of carrying us into the 1990's but could not even get us started into the 1980's. The old experiences could not deal with the new technologies that were on the horizon and the old training did not provide the ground work necessary to implement new concepts that were surfacing within the computer industry. We lacked creativity, inventiveness and a willingness to take risks.

In order to make changes we needed to know where we were, where we wanted to go and then determine how we would get there.

We had one central computer with 85 terminals supporting all academic and administrative functions. A decision to purchase a VAX 11/780 for academic support had just been made and our one full-time academic support person had resigned. We had developed an excellent on-line computer registration system in the mid-70's, but had not been able to develop other on-line systems. None of our systems were of a database design.

We went through an evolutionary development in determining where we wanted to go, an evolution that is still in progress. The following areas have been identified as important: database systems, on-line menu driven access, microcomputers, office automation, communications, networks, computer assisted instruction, faculty and staff training, management support systems and an environment conducive to change.

Three fundamentals important to a university environment have been identified - our computer systems must be easy to use, must enhance our students' educational experience, and must help our clients solve their business problems. Albert Einstein once stated that "the concern for man and his destiny must always be the chief interest of all technical effort."

It is important that our academic support staff understand the learning process, be familiar with the instructional environment and have teaching opportunities. They will not be able to contribute to the learning process until they understand the dynamics of the teacher-student interaction.

In the past our administrative computer applications have supported clerical processes. This is no longer sufficient. In the future they must directly support management decision making. An individual can bridge the gap between the business and technical areas only if they understand both areas. This demands broader levels of expertise among our staff.

We realized that we needed to begin a major change in order to provide the foundation necessary for future developments. There was no chance of changing the facilities we were in and to some extent the hardware or software systems that were available to us. The major opportunity for change lay within the staff, which would have to be productive in a rapidly changing technological environment.

Adaptability, creativity, development potential and a will to achieve must become as important in our staff selection process as experience, education and past accomplishments. What chance does a university have to hire this type of staff?

The Staffing Problem

This past summer one of the discussion sessions at the Academic Computer Center Directors Conference in Snowmass, Colorado, dealt with the issue of staffing our computer centers. The discussion began by listing the problems associated with the staffing process. These included:

1. The computer center has a poor image which hinders our ability to recruit our graduates, especially our better graduates.
2. University computer centers traditionally have lower salary scales than that of the surrounding businesses.
3. University computer center shops are often too small to allow adequate advancement opportunities.
4. The staff does not have the diversity and depth that is needed for today's highly technical environment.

5. The people we do get we train, and once they get experience they leave.

6. There are too few staff positions.

Each institution can add additional problems to this list but most of us have probably experienced many of these.

The Staff: The Most Important Asset

All organizations have several major assets, and computer centers are no different. We have hardware, software, facilities and staff. The most important of these resources is the staff. I have seen successful centers with hardware that is considered second rate and facilities that were atrocious. I have also seen centers fail even though they were equipped with the best of hardware, software and facilities. The key to success or failure is the staff.

Within the staff there are five important elements: the quality, quantity, depth of training, breadth of training and experience. Often times we are unable to control the quantity of staff that we have available. We all know, however, that there is a minimum threshold that is essential in order for us to have a survivable situation and we may find ourselves only able to tread water without enough strength to swim ahead. We must also have a balance in the breadth and depth of training and experience that is necessary to operate today's sophisticated information systems. Of these five factors the one that we may be able to have the most control over, and the one I believe we should put considerable emphasis on is the quality of the staff. There is no substitute for quality, but quality can often times substitute for lack of experience, training and quantity.

Staff Recruitment

At this stage we had determined where we were and where we wanted to go, now we needed to determine how to get there. In the past we had advertised locally, regionally and nationally, with little success. We still have found no set pattern to follow in our recruitment. The methods used since 1980 to hire each of the twenty plus individuals added to the staff offers many unique stories.

I convinced the Provost that I reported to in 1980 that we must have new blood, and we must start in a new direction. In the past I had submitted well prepared memos trying to justify positions, all without success. This time I simply pleaded for a new position and got it.

Now came the challenge of finding the person that would be the beginning of the change process. I would like to tell you that we ran a successful, well-planned recruiting and interviewing process and found the ideal person. It did not happen that way.

The day after the position was approved a former student of mine called and asked if we had any positions open. She had been one of the top students in one of my classes, had a B.S. in mathematics, an MBA and four years of experience including working with two different human resource systems. I, of course, said that we would consider her application along with all others and would call her back in a few weeks. Actually I interviewed her the next day and made an immediate offer which was accepted. This was the beginning of our change. It was also one of the quickest answers to prayer that I have had.

We needed to fill our Academic Assistant Director's position. Rather than fill it with an inadequately qualified person we borrowed a computer science faculty member one-half-time for a year. At the end of that year, out of desperation I started wandering around campus looking in all of our graduate student offices to see who would be finishing a Ph.D. that year. I found a physics graduate student who needed an additional year to finish his dissertation. He had a lot of potential and a good understanding of the teaching environment. A full-time salary compared to a graduate assistantship was attractive enough for him to accept the position.

As we realized the need to develop a data communications network on campus we approached a physics graduate student who was supported by a graduate assistantship from the Computation Center. His past experience in electronics, physics and television communications provided the desired background for this position.

Our first entry level programmer/analyst position was filled by convincing one of our bright computer science graduates that he could either enter graduate school and complete a masters degree in a year and a half, earning a graduate assistant's pay, or work full time at a competitive starting salary and complete the masters degree in three years, also gaining three years experience. This package deal was attractive to him.

Our start in Office Automation support began when I was able to obtain a one-half time position for an office assistant by eliminating a one-half time data entry position. One applicant only wanted to work half time so her job would not interfere with her tennis. Her business degree, several years of teaching in high school, initiative and having just initiated an office automation program in a large company provided the background necessary to manage our university office automation development.

One of the computer science faculty members worked part-time in the Center for several years. He would employ the better undergraduate students to work in the database programming group. On several occasions, when one of these students would be approaching graduation and we had a position to fill, we would make an offer before he began to interview for other positions. We now have four of our staff teaching part-time that help us employ the better undergraduates. From this group we get future full-time employees.

Until the summer of 1985 we had to actively sell students on the idea of working in the Computation Center. Now students, even the better students, come to the Center to see if we have any vacant positions. They have made the following observations: the better graduate students now work full time in the Center, some of their better teachers are full-time employees of the Center, our starting salaries are competitive and they can earn a master's degree and have three years full-time work experience in three years.

Recruitment is no longer the major problem so we can now turn our attention to the staff development process.

Interview and Selection

Before an interview takes place all information necessary for the selection process should be available and carefully reviewed. It is the candidate's responsibility to see that all forms, transcripts and letters of recommendation have been submitted. A candidate that does not take care of this responsibility will not take care of other responsibilities either. We also require the same information of all applicants no matter how well we know them. It is important that they understand the value of this process.

The interview should be at least one hour in length and have one other manager present. It should accomplish the following:

1. Verify information received.
2. Test the applicant's ability to communicate.
3. Transmit internal values and standards to the applicant.
4. Act as a training session for other management staff members in the interviewing process.

In addition to discussing the applicant's educational background, experience, test scores (GRE, ACT, SCT, GPA, etc., which show potential to learn) and future educational and training interests we ask them the following four questions:

1. Describe a past accomplishment and why you are proud of it.
2. Describe a problem that you have had and how you resolved it.
3. What was your most satisfying educational experience.
4. What was your most unsatisfying educational experience.

On several occasions the interview has caused us to reject a candidate that otherwise looked good on paper.

Candidates should be selected based on their ability to fill the immediate opening and their long term potential to develop through the ranks. Table 1 provides a listing of the skills required and behavior traits that are needed at various job levels. Potential, adaptability, creativity and a will to achieve are essential factors. An individual without long term advancement potential should not be employed.

We must either employ or grow individuals that have the critical factors necessary for us to have a balanced staff at the various job levels and with the proper mix of knowledge, skills and behavior to meet our changing and diverse information systems needs.

Staff Development and Advancement

We encourage staff development in three ways. All of our new staff must qualify for, have an interest in and enter a graduate program. We are rapidly approaching the time when almost all of our professional staff will hold an advanced degree. In the beginning we needed individuals with technical degrees such as computer science and computer engineering. We are now encouraging some of our staff to obtain advanced degrees in computer science and others to obtain degrees in business areas such as information systems and management.

We are also starting to hire individuals with degrees representative of our client support areas both in the academic and administrative sections. It is our experience that the computer center must build the bridge to the client areas, not vice versa; thus we are seeking a balance in the diversity and depth of the educational background of the staff.

Each year most of our staff will attend one or two professional meetings, seminars or short courses. These range from the technical to the applied. Employees are now encouraged to attend the professional meetings of our client departments, i.e. financial, registrar, instructional areas, etc.

As our staff gain experience, they are encouraged to submit papers for presentation at professional meetings and for publication. In this stage of computer development, any staff member that is not advancing is regressing. We must grow (develop) our staff.

As the number of staff members increase and they gain experience, we are creating advancement opportunities. These advancements are not given on the basis of seniority; there are more important criteria including:

1. The individual currently takes on added responsibilities, that is, he makes his job bigger.

2. There is a need within the computer center for this new position.

3. The individual works well with others and is respected by his peers.

4. The individual has demonstrated good judgement in past recommendations and decisions.

It is important not to promote individuals that have not already proven their ability for a new position. It not only hurts the computer center and the individual, but it also sends a message to the rest of the staff that promotions have no real value.

Timing is important. When we sense that a staff member who has proven himself is beginning to feel the need for advancement for whatever reason (financial, recognition, etc) and an opportunity can be justified, we will act. This has kept us from having to fill several positions where resignations would have resulted. We also keep individuals informed as to when an opportunity may be available.

Staff Needs

We may be able to recruit the best of talent but if we are not able to meet the fundamental needs of these employees we will not be able to keep them. These needs go far beyond the food, clothing and shelter that man needs to survive. Frank Stanley provides a list[2] of thirteen staff needs for our work environment:

1. Achievement
2. Recognition
3. Work itself
4. Responsibility
5. Advancement opportunity
6. Growth
7. Salary
8. Relationships
9. Status
10. Company policies
11. Working conditions
12. Personal needs
13. Security

Our staff needs a work environment that provides love, joy, peace and hope. As managers we must be able to provide these.

Management of the Computer Center

The management of a highly technical staff in a structured university environment and in the midst of a rapidly changing, unstructured computing environment is now our major challenge. In order to develop a management approach we must first identify the basic leadership tasks of the Director of the Computer Center. They are:

1. To get results
2. To grow (develop) people.
3. To set and transmit values.
4. To motivate the staff.

The first two came to my attention in a paper[3] given by Brian Walsh, formerly Director of the Notre Dame Computing Center. They are worth our consideration. The classic functions of planning, organizing and controlling are important management functions, but do not in themselves provide leadership.

Peters and Waterman expound these ideas in their discussions.[4] "Managers prefer working with people, leaders stir emotion" and excitement. Our excellent organizations "create an environment in which people can blossom, develop self-esteem, and otherwise be excited participants." Leadership "builds on man's need for meaning, leadership creates institutional purpose."

They go on to say that leadership, "is patient,...alters agendas so that new priorities get enough attention,...is invisible when things are working well,...is building a loyal team at the top that speaks more or less with one voice,...listens carefully much of the time,...is tough when necessary." The leader is the "value shaper, the exemplar, the maker of meaning.' All of these put together provide the staff with a reason to produce results and a motivation to want to grow.

As we are reminded that our staff are our most valuable resource we can agree with the senior Japanese executive who stated, "We are very different from the rest of the world. Our only natural resource is the hard work of our people."[5]

Results

All of the staff members that we have hired during the past five years under the new process are still at Baylor. This is a major accomplishment. We have moved from less than one degree per stall member to 1.6 as is shown in Table 2. When the 9 now working on M.S. degrees complete them the ratio will be 2.0. The staff is now very young with 18 of 23 having 10 years experience or less. We have a broad range of degrees represented. Major developments have been made in our database, academic, office automation and communications sections.

---

1. Thomas J. Peters and Robert H. Waterman, Jr., In Search of Excellence (New York: Warner Book, Inc. 1984) p. 74.
2. Robert E. Umbaugh, Ed., The Handbook of MIS Management (Pennsauken NJ: Auerbach Publishers Inc, 1985) p. 578.
3. R. Brian Walsh, "The Management of a Highly Technical and Structured Service Unit within an Unstructured Technical Environment," Proceedings of the Fifth Annual Seminar for Directors of Academic Computing Services, August 1974, p. 85.
4. Peters and Waterman, p. 84-86.
5. Peters and Waterman, p. 39.

TABLE 1

COMPUTER CENTER STAFF REQUIREMENTS

Job Level	Staff Requirements		
	Knowledge Required	Skills Required	Behavior Traits
Entry Programmer	Programming	Idea organization and presentation	Problem solving Client oriented
System Analyst	Client needs -departmental	Analyzing Documentation Listening Creative	Active information seeking Efficient
Project Manager	University needs -local	Leadership Integration Good judgement Responsible	Excellent communications Results oriented Initiative
Section Manager	University needs -national	Planning Communicating Decision making Value shaping	Excitement Institutional leadership

TABLE 2

NUMBER OF DEGREES OF STAFF

MAJOR	B.S.	M.S.	(IN PROGRESS)	PH.D.
Computer Science	12		(8)	
Business	3	1	(1)	
Physics	3	4		2
Mathematics	2	2		
Educational Systems				1
Other	4	2	(1)	
TOTAL	24	9	(10)	3

Total Degrees earned by 23 staff: 36
Ave. Degrees per Staff: 1.6
Ave. Degrees & In Progress per Staff: 2.0

PROFESSIONAL STAFF EXPERIENCE

Years Experience	Number of Staff
0 to 5	11
6 to 10	7
24 to 40	5

ORGANIZING FOR MORE EFFECTIVE END USER COMPUTING

DENIS PICKRON

RICK SEAMAN

UNIVERSITY OF VIRGINIA

CHARLOTTESVILLE
VIRGINIA

Consumers of data processing resources have become much more self-sufficient and sophisticated in recent years. Although data processing departments have altered their perspectives, services and organizations to meet the new demands, the organizations are not positioned to consolidate these independent efforts into highly coordinated interaction. Many institutions are at a point where the end users and data processors are approaching real limitations on productivity while experiencing increasing needs for automated problem solving.

This presentation will show the historical evolution towards the current environment from the differing points of view of the data processor and the end user. A suggestion toward consolidating the organizations will be presented for your consideration.

In the beginning, the data processor was a technician and the end user was his client. They existed as separate entities. The barrier of technology was high enough that their attempt to identify an automated solution to a business problem was often uncoordinated and unsuccessful.

The user had no expectations about what a computerized system should be. Even so, the results were often disappointing. They did not understand the technology well enough to know what was possible or how to describe their business problems in a way that the technician could understand.

Although there was a lot of satisfaction in being a technical wizard, the data processor paid a price for this flexibility later on. The client was constantly requesting enhancements to a perfectly good system until the system began to be patched like a quilt. The original system documentation often disappeared when the napkin that the original specifications were written on was thrown away. The technical aspects of the job were so demanding that there was limited time and interest in learning more about the client's business environment and problems.

This novice-to-expert relationship continued for quite a few years until the technology became easier to understand and the client began to see through the mystique and the technicians had time to learn more about the user's business problems. Then, the clients evolved into users, the technicians became advisor/builders and their organizations, while still separate, moved into a more intimate relationship.

Although the data processors became much more aware of the user's needs and had development tools which greatly increased their productivity, this increased productivity led to increasing user demands and an increasing backlog of work. The increase in quality and consistency associated with the new system development methodologies came with an associated cost in time. Unfortunately, the user still had expectations based upon the more expedient systems development of the past.

From the user's perspective, the situation had gotten both better and worse. They were feeling much more comfortable with computing technology and were beginning to see how to make it work for them. The quality of the systems they were receiving had improved greatly. However, they felt increased frustration with the time it took to get projects accomplished and their dependence on a service over which they had very little control. In an effort to reduce this dependence and backlog which was creating unacceptable system delays, many computing organizations established Information Centers to address and satisy the user's simpler requirements. Generally, Information Centers were developed with small staffs to be on call to support all users and their diverse problems. While they were more aware of user needs, it was difficult for these organizations to devote resources to long-term project development and subsequent maintenance. The user is often required to accomplish much of this type of development while occasionally getting assistance from the I.C. This has not always worked out well since the users are not full-time programmers and have only limited tools and training. Often their expectations exceed their abilities. Some institutions have taken the next step toward independent end user computing and created departments within the organization to establish user computing coordinators. These users, with data processing experience, supplement the services provided by the central computing organization. They act as coach, shepherd and information specialist for all end user computing activity that occurs within their department. They may plan and implement hardware and software acquisitions for their departments and do systems development work at the request and direction of the department manager. With the establishment of departmental information specialists and an independent end user coordinator, institutions have begun to realize the potential of user-directed data processing. They enjoy a great deal of independence and feel that they are starting to control their own destinies. However, there are a number of risks associated with the end users developing their own systems independently of the data processing department. They may miss out on years of existing experience and will most likely reinvent the wheel while learning the same lessons already learned by data processing. The likelihood of data and personnel inefficiency and redundancy within the University is a certainty as different departments satisfy their computing needs without coordination with the activities of other departments. Even if the user computing department overcomes these handicaps through the hard work of diligent employees, they will always be extremely vulnerable to the turnover of these key employees.

Anyone who is involved with end user computing may be at the point of making a decision about the direction needed not only with user-directed computing, but also with all data processing at their institution. The industry trends indicate that the users are at a point where we may begin to break away from the centralized data processing model and develop independent data processing units. Users are starting to establish independent systems and operations using micro networks and departmental minicomputers. Some central computing organizations have attempted to control maverick user computing efforts by instituting "hard" controls on purchasing and/or independent systems development. Other central computing organizations have taken a hands-off approach either because they do not want to deal with the issue or because they feel that, given enough rope, the users will surely hang themselves. Regardless of which way data processing responds to the independence of end user computing, the results will be that a wedge will be driven between the two groups, and the resulting competition and conflict will work to the detriment of both groups and the University.

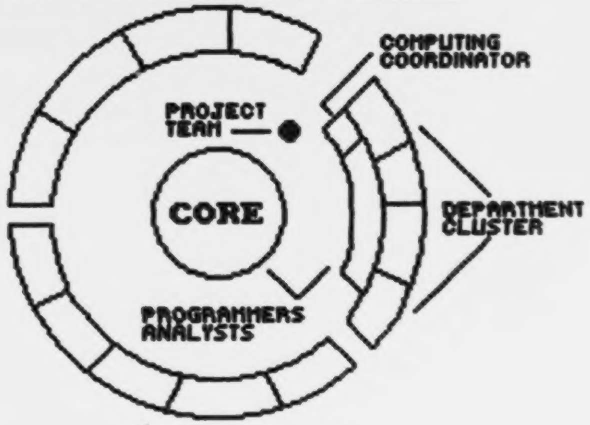
An alternative might be to consolidate functional computing groups within the University into a partnership which solves problems through cooperation. Think of the individual departments of an institution as forming an administrative service ring. Within the ring, these departments are usually grouped by functional areas (such as Student Services or Finance) into departmental clusters. Each of these clusters could have their own data processing staff, trained and certified by the central computing organization. The number and sophistication of the resources would depend on the needs of each cluster. These departmental resources could provide: ad hoc reporting, departmental resources for major systems development projects, technical consulting to department managers, prototype development for small systems and most maintenance and enhancements of mainframe production systems. This shift of responsibilities would necessitate a redefinition of the role of the central computing organization. Working toward this new environment of cooperation, the data processing organization might also be modified. The central administrative computing function is represented by an organization referred to as the "CORE". This group would be responsible for:

Coordination of System Development
Oversight of Production Systems
Repository for data, documentation, standards and programs
Education of all University computing resources

This computing CORE organization is composed of the staff necessary to support the functions which have a need to be centralized such as: Technical Services/Operations; Data Administration/Security; Applications Coordination (Standards/ Documentation, Project Leadership, Master programmer pool); Information Center and Training.

All project development would occur outside both the computing CORE and the administrative departments. The project teams would be staffed from both these areas but would exist as a completely independent entity for the life of the project. The project team could draw from the additional expertise within the computing CORE and administrative areas as needed. The typical makeup of a project team would draw upon the administrative departments for the Project manager, business analysts, maintenance programmers and the programmer analysts and from the central computing CORE for the project leader, system analysts and master programmers/analysts.

ADMINISTRATIVE WHEEL



A key consideration of this proposal is: what happens to a system once the development project is completed? The department(s) that own the system should be responsible for any maintenance to it which does not require creation of another project team. In order to ensure the ongoing viability and integrity of the system however, the computing Core must coordinate the planned modifications and be the repository of all source code and systems documentation. It is the intent of this proposal that generally accepted computing practices not be compromised.

The Departmental Computing Coordinator would act as an agent of the central computing CORE to perform the following functions:

coordinating initial data preparation and control
coordinating system modification requests/monitoring progress
enforcing standard system development/computing procedures
performing the initial review of program/documentation changes.

The barriers that exist between consumers and providers of data processing services are, today, largely psychological and are based on a notion that computing consumers and providers should be kept at arms-length from each other. We will all be more productive if we mingle computing professionals and business professionals and create an organized and coordinated partnership.

Many institutions are at a point today where a direction for the future should be set. It seems likely that if no conscious effort is made to bring the groups closer together they will automatically drift apart. Data processors are perceived by users as purists who have circled their wagons in order to preserve a pure environment. The end users are perceived by data processing as mavericks who are pursuing quick and dirty solutions. In order for the data processors to capitalize on the knowledge and abilities of the end user and to get closer to the business problems to be solved, it will be necessary for them to relax their constraints and territorial mindset and join with the users to form a functional partnership by extending their organization into the administrative departments. In order for the end users to fully participate in automated problem solving and to enter the computing mainstream, they will have to sacrifice some of their freedom to pursue fast and loose system solutions and accept some of the data processing disciplines and standards. Thomas Jefferson, it seems, has something quotable for almost any occasion: "Here, we are not afraid to follow truth wherever it may lead, nor to tolerate any error so long as reason is left to combat it".

FACILITATING THE USE OF MICROCOMPUTERS ON CAMPUS THROUGH THE CONCENTRIC CIRCLE MODEL

Dr. Julie Carnahan
Executive Assistant to the Chancellor

Dr. Dennis M. Edwards
Assistant Vice Chancellor (Academic Affairs)

University of Alaska, Anchorage
Anchorage, Alaska

ABSTRACT

The proliferation of microcomputers on campus has brought about the need for resources to support microcomputer users. Many campuses have established centralized offices which provide technical support for microcomputer users through the use of formalized instruction, or informally on an as needs basis.

It is clear that many microcomputer users (or potential users) will not take advantage of the resources of a centralized office but would benefit from another approach of delivering technical support.

This paper will describe a model used for providing technical support to microcomputer users which encourages the diffusion of microcomputer competency across the campus.

FACILITATING THE USE OF MICROCOMPUTERS ON CAMPUS THROUGH THE CONCENTRIC CIRCLE MODEL

INTRODUCTION

Virtually every college and university has felt the impact of the proliferation of microcomputers on campus. The advances in microcomputer technology,both hardware and software, have put computational power in the hands of faculty, staff and students today that was only available on a handful of mainframes just twenty years ago. Indeed, there is substantial evidence that the technological advances have outstripped the ability of the users. Resistance and anxiety to computers have plagued many campuses inhibiting the full creative use of the technology.

In a search to assist and even stimulate the acceptance of microcomputers on campus, many institutions have established centralized computer information centers.[1]

While such efforts have been successful, they often primarily reach the more experienced users. In such a situation the education of the novice user often is left to more haphazard interaction within the organization.

PURPOSE

The purpose of this paper is to identify a model for the dissemination of microcomputer information that can provide a framework for administrative planning and for further research.

APPROACH

The approach is to examine the concept of concentric circles, and to apply that concept to the dissemination of microcomputer information.

THE CONCENTRIC CIRCLE

The term "concentric circle" is formulated here to describe the network of informal interaction by individuals across the campus who are exchanging information about microcomputer technology. Just as technology is changing, there is considerable evidence in the literature to suggest that the way employees interact in the workplace is also changing.

Alvin Toffler speaks to the changes in the needs of workers in his book The Third Wave. He categorizes the progression of civilization in three "waves". The First Wave was precipitated by the invention of agriculture. The Industrial Revolution triggered the Second Wave. Toffler suggests that now what we are experiencing is the Third Wave, a new civilization creating signal changes in society, the earth, and humankind. The Third Wave will reveal a workforce seeking more responsibility and commitment to work that fully utilizes their talents and a workforce that is more aware of how their work dovetails with that of others in the organization.[2]

David Reisman in his work, The Lonely Crowd depicts a similar theme of the individual today being drawn to a greater dependence on peer groups, a departure from the historical need for self-reliance.[3]

Work by Virginia Hire and others has identified the recent shift in the Western World from a hierarchal society characterized by more rigid formal structures to one that is more egalitarian with increased reliance upon networks to accomplish specific tasks.[4]

John Naisbitt in his best seller Megatrends identifies such shifts in the sociological structure among the ten most important "new directions transforming our lives."[5]

The concept of networking has been applied to the overall process of establishing links horizontally as well as vertically in and out of organizations. Evidence of the successful application of such networking is visible in many of the Japanese companies and in a growing number of the most successful American firms as they establish quality circles to increase productivity and worker satisfaction. Avon Products and Pacific Gas and Electric are two of a number of companies who have noted benefits from micro-computer experts decentralized throughout the organization.[6]

The concentric circle, is similar to quality circles in that both have the common goal of improving organizational productivity and communication; and both depend on the effectiveness of the circle facilitator. However, the concentric circle differs from the quality circle in a number of important ways.

First, concentric circles emerge on their own without formal organizational involvement, as contrasted with quality circles which are a result of direct management intervention. Second, the concentric circle, as proposed here, brings together individuals from across organizational levels, whereas quality circles tend to be made up of people doing the same or similar work within one unit. Third, the concentric circle does not focus on increasing its member's participation in organizational management, while quality circles purport to be established with this objective in mind. While concentric circles and quality circles have much in common they differ in origin, scope, and focus.

Facilitating the use of microcomputers on campus through the concentric circle model should produce positive outcomes similar to those documented with the establishment of quality circles. This can be accomplished by formally recognizing and supporting concentric circle leaders who form the primary circle (see Figure 1).

APPLICATION

The application of the concentric circle model in the dissemination of information on microcomputers is a three step process:

A) Identify leaders of the primary circle
B) Institutionalize the concentric circle
C) Reinforce the concentric circle

In facilitating the use of microcomputers it should be emphasized that the concentric circle model is a structure to facilitate the process of interaction. As such, the process is more important than the structure.

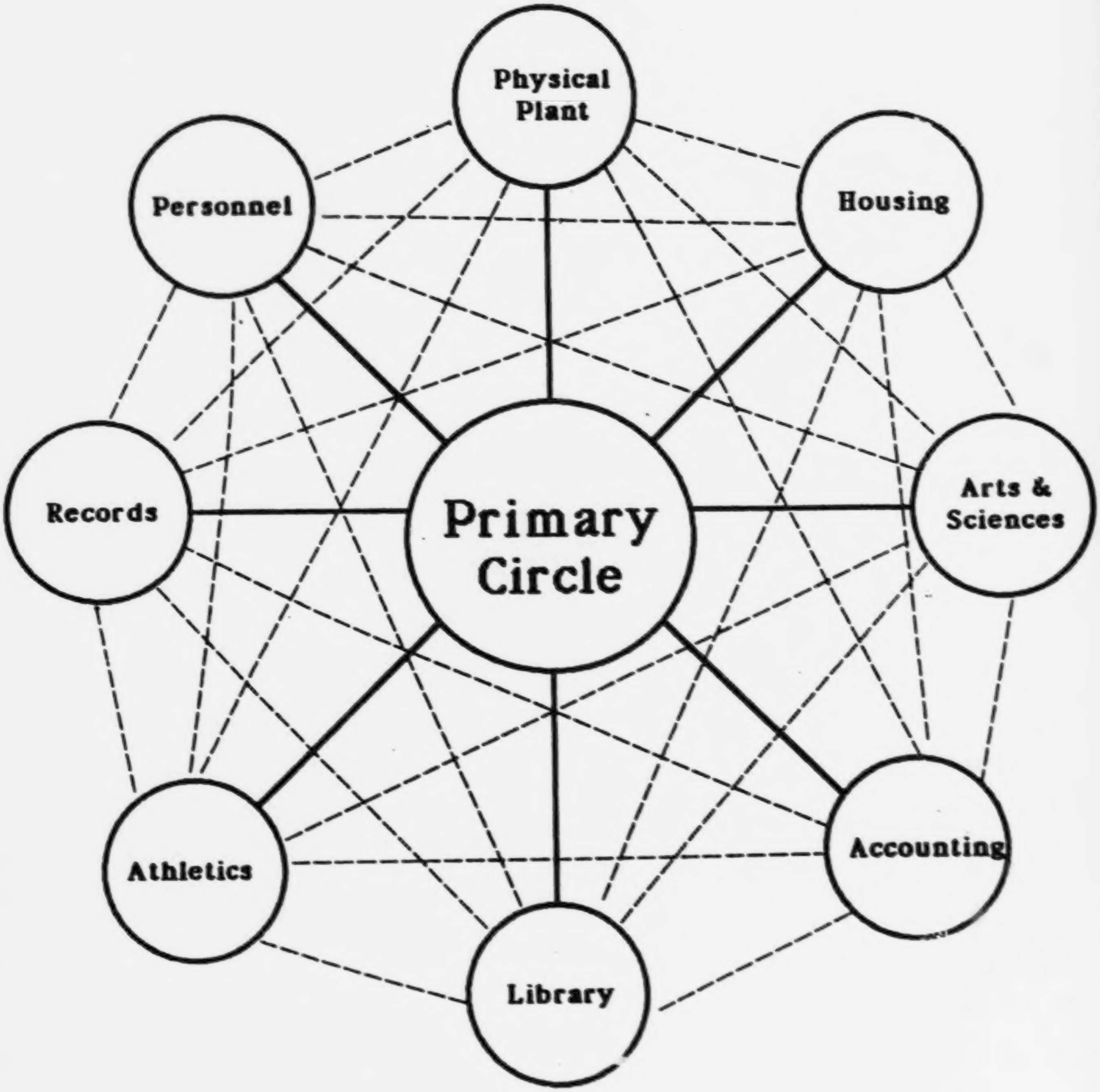
Identify Leaders of the Primary Circle

The process of identifying the most ideal members for the primary circle involves knowing the distribution of microcomputers within the organization; knowing the characteristics of the various members of the organization; and selecting those individuals most likely to succeed.

In examining the distribution of equipment within the organization, one must do more than simply look at a list of equipment. At the University of Alaska, Anchorage (UAA), each terminal was plotted on an organizational chart and color coded to represent the type of equipment. This enables those selecting individuals for membership in the primary circle to see at a glance the organizational location of the microcomputers.

FIGURE 1

The Concentric Circle Concept


Physical Plant
Personnel
Housing
Records
Primary Circle
Arts & Sciences
Athletics
Accounting
Library

The facilitator of the primary circle should be someone who exemplifies the dual characteristics sought in all members of the circle. That is, she or he should be technically competent in the use of microcomputers and have the ability to teach others to use them effectively.

Once the primary facilitator is identified, she or he can assist in the identification of other potential members. As a general rule, it is suggested that the initial size of the group be fixed at eight to twelve members to facilitate interaction. The very nature of the model provides for the formation of additional circles. It is important that those initially involved in the primary circle support the concept. They can in turn identify others who will make good members of subsequent circles. At UAA, members were identified from throughout the organization to maximize the ripple effect of the circle.

Institutionalize the Concentric Circle

Every institution has a cadre of formal leaders whose influence initially flows from their position within the organization. Likewise, every institution has a number of informal leaders who influence others by virtue of the manner in which they interact. The concentric circle model is the institutionalization of informal instruction that is already taking place across the campus. This is initiated by bringing together concentric circle leaders into a primary circle with the following agendas:

Meeting I

1. Introductions
2. Importance of technological improvements
3. Problem of providing adequate training for new users
4. Special characteristics of those selected to attend
5. Concentric Circle Model concept
6. Invitation to participate

Meeting II

1. Review of Meeting I
2. Discussion and selection of goals
3. Discussion of incentives for participation
4. Discussion of opportunities to give concentric circle members recognition within the organization

The purpose of the meetings is to institutionalize the participation of the informal leaders in the goals of the formal organization.

Reinforce the Concentric Circle

For members of the Concentric Circle to sustain their direction and enthusiasm, some type of reinforcement should be provided. Under the model developed at UAA, individual reinforcement comes from three sources: formal recognition by the institution; hardware and software preference for circle members; and the intrinsic rewards that come from teaching others.

Formal recognition includes 1) announcement of the formation and purpose of the group through official channels--the higher the rank of the official releasing the information, the better (i.e. the President as opposed to the Dean) 2) periodic reports on the activities of the group designed to generate institutional enthusiasm and support 3) formal citation of primary circle member's participation.

Because the members of the primary circle are selected for both their technical competence and their ability to teach others, it is logical that enhancements to their technical competence should be rewarding. Offering new equipment and/or software to members of the primary circle acts as reinforcement for their participation. Additionally, as the group is so rewarded its status within the organization is enhanced.

Teaching others can be a very rewarding experience as attested to by the large number of faculty who take up the career despite its general financial limitations.
Since the selection of the primary group leaders presupposes that the leaders are people oriented and enjoy helping others learn, some of the reward will be intrinsic. This can be reinforced by encouraging group members to discuss their teaching techniques and calling attention to the individual successes of the leaders.

In summary, the reinforcement for the concentric circle can be through formal recognition, hardware or software benefits or through the intrinsic value of teaching. While all of these take some planning and thought, one of the great strengths of the concentric circle model is that it need not be expensive to support. Most aspects of the model are, in fact, things that a good manager would want to do anyway.

CONCLUSION

The concentric circle model as currently in use at UAA is emerging as a viable alternative for encouraging and enhancing the use of microcomputers across the campus. The model appears to be an effective means of reaching those individuals who would not participate in structured classroom settings or make use of traditional computer information centers. Further, it offers institutional rewards for those who help others become more sophisticated users.

The implications for institutional administrators are intriguing, in that, the continued proliferation of computers will undoubtedly impact administrative processes and decision making in the future.

Footnotes:

1. B. Dooley, "Info Centers: Do you need one?", Management Information Systems, August, 1985.

2. Alvin Toffler, The Third Wave (New York: William Morrow Company, 1980).

3. David Reisman, The Lonely Crowd (New Haven : Yale University Press, 1950).

4. Virginia Hire, "The Basic Paradigm of a Future Socio-Cultural System," World Issues, April - May, 1977.

5. John Naisbett, Megatrends (New York: Warner Books, 1982).

6. Charles Rubin, "In-house PC Gurus Ease MIS's Support Burden," PC Weekly, May, 1986.

END-USER COMPUTING
AT
THE PENNSYLVANIA STATE UNIVERSITY

Kenneth C. Blythe

The Pennsylvania State University
University Park, Pennsylvania

A combination of policy, resource allocation and institutional change has been required to support the "user initiative" at Penn State University. From the top down, there has been a desire to make computing accessible to local offices. It began in 1981 with the introduction of the 4th Generation programming language NATURAL, and the relational database, ADABAS. Successful involvement of users has been achieved with the clear signal that they are responsible; users must demonstrate their need and finance their participation. Each user office operates according to its own "initiative" with a few setting the pace. The central administrative computing office is a strong player in the "user initiative" and provides the structural base which enables it to flourish. Training and certification is provided at a variety of skill levels from simple inquiries to data downloading. The "user initiative" at Penn State University has shown that user involvement does not just happen; it evolves from a commitment to make it happen.

END-USER COMPUTING...
THE CONTINUING EVOLUTION

The inexorable rise of end-user computing in the latter half of this decade can not surprise those who have witnessed the evolution of computing in organizations and society. In the 1980's, computers have become as much a part of living as radio and television did in the 1930's and 1950's. Bits, bauds, memory and modems are commonplace terms among young people today. Mathematics is being taught with calculators. Children are accustomed to computers as instruments for solving complex problems. These same children, when they mature, will continue to resort to computers to solve complex organizational problems. People are growing comfortable with computers and computers are proliferating in organizations. "End-user computing" is here. What, if anything, are we going to do about it? Fight it? Ignore it? Or, "embrace" it as the next stage of computing in organizations. This is a paper about "embracing" end-user computing.

THE MONOPOLISTIC ERA

In 1933, computing began at Penn State with the installation of a 7-Bank Electric Accounting Machine, a Horizontal Sorting Machine and three Electric Key Punch Machines. As you might suspect, these machines were first put to work on payroll. 1933 was also the beginning of the "MONOPOLISTIC ERA" of end-user computing as described by Gerrity and Rockart.[1] From 1933 through the mid-1970's, Administrative Computing at Penn State was the sole domain of a single organization known originally as the Tabulating Department later changed to Management Services. Throughout the MONOPOLISTIC ERA, central data processing saw a need to serve end-users, but did not have the proper tools. Its work was regarded as a specialty, much like printing, photography and publishing is today. It was compartmentalized and limited by the technology of the times.

In 1958, the first electronic computer, an IBM 650, was installed at the University and featured stored-programming capability. This new machine encouraged rapid expansion of computing applications in Accounting, Alumni, Academic Records and Admissions. The IBM 650 was a single thread machine that could perform only one task at a time. It had less than 10,000 characters of memory and no terminals. The applications were basically card processing replacements that were aimed at operational efficiency rather than informational analysis. In time, the IBM 650 was replaced by larger IBM computers but the transition from operational systems to informational systems was slow.

Throughout the MONOPOLISTIC ERA, there was no need for integrating applications since each application stood alone. The emerging need for management information made it necessary to reduce application separation and data redundancy. By 1968, with in installation of on-line terminals, the

---

[1] Thomas Gerrity and John Rockart, "End-user Computing: Are you a Leader or a Laggard?" Sloan Management Review, Summer 1986, pp. 25-34

Bursar's office began sharing information with the Registrar; Payroll began sharing on-line information with Personnel. The problems of stand alone applications became apparent. Accuracy and timeliness were important. Cross office processing was increasing. It was obvious that applications had to be integrated. The MONOPOLISTIC ERA found its culmination in the "Total System;" a concept that was overtaken by time. Penn State did not achieve a "Total System" because database technology was not sufficiently developed to support it. Neither were the users. Today, it is obvious that an Integrated Database (the modern equivalent of the "Total System") requires a knowledgeable, involved and committed user community. Before Penn State was ready to develop a "Total System," it had to move beyond compartmentalized, specialized and centralized administrative computing. Users had to become partners.

THE LAISSEZ-FAIRE ERA

It seems that progress occurs only after extreme conditions have been reached. The pendulum must swing far to the right before it can return to the left again. The natural course followed by most organizations, and certainly that of Penn State, requires them to pass through an era of LAISSEZ-FAIRE before achieving balanced end-user computing. By the early 1970's, it was clear that the MONOPOLISTIC order was passing and something else was taking its place. The first signs were that the "Total System" approach was failing. More importantly, it was not possible to produce useful "management information" out of the operational systems that were in place. To compensate for these failings, an entirely new organization was established, outside of Management Services, to analyze data. This new organization was not saddled with the day-to-day operational responsibilities of Management Services. It had, and still has, the freedom to use data, creatively, to defend Penn State's instruction, research and service goals. This office is now known as the Office of Budget and Resource Analysis. Instead of processing data, it uses data. Its activities are not compartmentalized as with Management Services. A variety of computer files are used; both internal and external to the University. Statistical tools available at the Academic Computation Center are used to analyze, correlate and extrapolate meaningful results from data. Compartmental limitations of Management Services are bypassed, screening out redundancy and bridging between divergent systems. This new organization is "data oriented," not "process oriented." The information that it produces is used by the highest levels of University management to make sound arguments about the University's future.

Another clear indicator of the LAISSEZ-FAIRE ERA was the expansion of distributed computing. Originally, Penn State had little knowledge of word processors and office computers, so they were controlled by Management Services. The early machines were expensive and their functionality limited. It was not clear whether they were downsized computers or upsized typewriters. The relentless search to improve office productivity throughout the University, however, demanded that a separate organization be established to foster and encourage reasonable office automation solutions. Again, from the beginning, this organization was not limited by the compartmentalized, centralized solutions of Management Services. Its objectives were to seek solutions that were most appropriate to a variety of office needs. Recommended solutions were independent of the central computing office because they were thought not to be relevant to central computing. The solutions provided local and immediate results. There was little concern for compatibility or sharing outside the local office.

In time, local word processors grew to be departmental processors and word processing grew to data processing. By the late 1970's, departmental data processing solutions became apparent, most often in auxiliary enterprises which were unique and separate from the University-wide solutions. Specialized computers have been and are being used at Penn State to support Book Stores, Dining Halls, Food Services, Central Control of Buildings, Health Center Operation, Police Services, etc. Each of these computers is improving the University's ability to plan, manage and control vital services. Each has also contributed to the general accessibility and awareness of computing. The LAISSEZ-FAIRE ERA dashed the notion, once and for all, that computing is the eminent domain of a specialized organization; it is, instead, a capability that is required in diverse ways throughout the institution. The LAISSEZ-FAIRE ERA opened the door to a real partnership - one which provided exciting new possibilities for sharing complementary strengths and working together towards an excellent University.

DATABASE ERA

It is not intuitively obvious that a database draws users and central computing together, but it does. As early as 1969, the University envisioned the need for an integrated database. In December 1969, President Eric A. Walker (Pennsylvania State University President 1956-1970) established a Directorate to implement a University-wide Management Information System with an Integrated Database. This vision was pursued throughout the 1970's. Not until 1981, however, did the vision finally become clear. With hindsight, it is apparent that an integrated database was required in 1969 but was neither technologically nor organizationally feasible at the time. President Walker was too early. Comparing disk storage and cpu cycles alone, Penn State's modern databases run on machines 50 times more powerful than those available in 1969. Beyond that, Penn State was not organizationally ready for an integrated database - it had not gone through the LAISSEZ-FAIRE ERA.

The DATABASE ERA brought with it a realization that organizations have to behave in an integrated way to achieve a fully integrated database. End-users must work together, among themselves and with central computing, throughout the design, development and implementation of systems. The institution as a whole has to rally around a common objective - this is not a simple undertaking! The database is the instrument that focuses the institution; it is the precursor of end-user computing. In 1969, the "Management Information System" was thought to be separate from operational systems. Hindsight now shows that such separation is unrealistic. The integrated database provides both horizontal integration and vertical integration - the database is of little value if it does not integrate strategic, management and operational computer systems. To achieve this unity, end-users are called on to define organizational objectives as well as operational objectives. Perceptions change. The goals of the University take precedence over the sub-optimal goals of the separate offices of the University.

After a decade of false starts, President John W. Oswald (1970-1983) charged a Presidential Task Force to recommend a course of action to achieve an integrated Administrative Information System (AIS) for Penn State. The Task Force concluded that it was necessary to hire an independent contractor to steer Penn State into the DATABASE ERA. Among other findings was the fact that Penn State was following the traditional "Nolan Curve" of development and was in Nolan's Control Stage, Stage III (characterized by frustration with results and concern about escalating costs).[2] Nolan claimed, and the Task Force agreed, that it was necessary to retrofit existing application systems in order to move to Stage IV, Integration. The independent contractor was the catalyst to make it happen. In April 1982, Penn State contracted with Electronic Data Systems Corporation (EDS) to design an integrated database for six administrative areas and implement the database in one of those areas, the Student area. By early 1985, EDS had completed its work and the Student Systems were turned over to Management Services for maintenance. The indirect results of the EDS contract were more beneficial, however, than the designs and systems that were turned over. EDS successfully united diverse user offices with a common purpose and a common plan. It also shed central computing of its last vestiges of monopolistic computing. The users and central computing became partners.

INFORMATION RESOURCE MANAGEMENT ERA

Today, Penn State is still retrofitting its administrative systems into the integrated framework. This work will continue through 1989, at least. The integrated Student Systems are everything that they promised to be. Student Registration, for example, is integrated with the Bursar to prevent instruction without payment. Financial Aid is integrated with Academic Records to prevent aid to students who are academically ineligible. Housing is integrated to prevent room assignments to students who are not registered. Academic Departments are integrated to prevent students from graduating who are not approved by the Dean. The Faculty Senate is integrated to insure that only courses approved by the Senate are taught. The systems used at the largest campus (at University Park) are also used at the smallest. Penn State is truly a single University of 22 dispersed campuses because of its integrated database. The database would not have been possible without the tireless dedication of the Registrar's Office, Bursar's Office, Admission's Office, Colleges, Campuses and many others who worked toward the single objective of having an integrated database. These users are now the driving force behind continued improvement, development and utility of computer systems.

Prerequisites

End-user computing is a reality at Penn State but we have barely scratched the surface. We know that the next decade will bring a new generation of end-users who will be every bit as talented in computing as they will be in their own disciplines. Computers will differentiate progressive organizations and institutions. End-users will be looking to the strategic value of data to assist in decision-making, allocate scarce resources and analyze alternative courses of action. To provide a rich opportunity for using data, experience at Penn State shows that these are prerequisites:

---

[2] Richard L. Nolan, "Managing the Crisis in Data Processing," Harvard Business Review, March-April 1979, pp. 115-126

- Policies which encourage end-user computing
- Integrated relational databases
- Fourth Generation languages
- Distributed telecommunications network
- Security at the file and element level
- Emphasis on education

Collectively, these prerequisites characterize the INFORMATION RESOURCES MANAGEMENT ERA. In this ERA, data must be administered in a way that encourages its use; policies and procedures must be established to accomplish this purpose.

User Initiative Committee

Upon examination, in 1985, many of the policies and procedures at Penn State were found to be oriented toward monopolistic computing. While the University had been maturing, many of the policies and procedures had not. To rectify this situation, a User Initiative Committee was appointed to bring the policies up to date. This Committee is represented by Academic Services (Registrar, Admissions, etc.), Controller, Budget, Business, Human Resources and Management Services. The Committee has nearly completed its work and has documented many changes. A new policy, AD-23, has been published which provides for "Use of Computerized Institutional Data." On the surface, such a policy would seem unnecessary - the use of data seems self-evident. But, AD-23 explains the rights and responsibilities of users, as well as, stewards of the data. AD-23 also establishes the basis for which approval is given, daily, to new users to use data. The Committee also prepared a Data Administration Charter which explains the purpose and value of administering data in the University. Again, this is a point which might seem self-evident. It is not! The Committee revised the basic policies which govern data security and penalties associated with unauthorized use or access of data. It prepared a document to explain the complementary roles of central computing and end-user computing. The document explains that users are responsible for entering and using data while central computing is responsible for administering and processing it accurately. Users write programs to inquire against data while Management Services writes programs to update and maintain data. Penn State's User Initiative Committee is producing documents which shift the orientation of computing to a partnership between end-users and central computing.

Information Retrieval Working Group

Time has shown that the User Initiative Committee is comprised of atypical end-users. They are members of a larger circle of central computing elite; organizations closely affiliated with computing at Penn State over the past twenty years. They have come to be known as "the operational offices" as contrasted to true end-users in colleges, campuses and academic departments. To a great extent, the central operating offices are as sophisticated and versatile in their use of computing as Management Services itself. To expand the circle, and bring the concerns of more end-users to light, a second committee (the Information Retrieval Working Group (IRWG)) was appointed at Penn State. IRWG is made up of campus representatives, colleges, central student services offices and other non-traditional computing organizations. IRWG has discovered "pockets" of successful end-user computing throughout the University. IRWG has become a forum for highlighting these successes. IRWG has also become a support group for offices wishing to use data but not knowing how. All the policies in the world are not a substitute for the creativity that occurs when people with like problems meet and compare experiences.

Resource Allocation

End-user computing is more than ideas and committees; it is a shift in resources. More is spent, for example, on databases that are shared by end-users than otherwise. More is spent on computers to run programs written in fourth generation languages. More computer equipment is required to support the additional "programmers" resulting from end-user computing. More programmers naturally means more demand for computer equipment. Offsetting higher computer equipment cost, however, is the reduced cost of more productive programmers both in user offices and in the central computing office; trading people productivity for equipment expense. End-user computing changes investment from central computing equipment, exclusively, to an increased overall expenditure for both central computers and distributed computers. End-user computing is a shift towards higher telecommunication costs and data storage costs to support the varieties of work files, file sharing and associated files used by end-users.

CONCLUSION: A CONTINUING EVOLUTION

At Penn State University, the question is not if but when and how fast should end-user computing expand. The fact that computers are becoming tools of the proletariat is indisputable. Either we manage end-user computing or it will manage us. From the top down, at Penn State University there is a realization that policy, resource allocation and institutional change is required to accompany the "User Initiative." It is not an urgent issue as much as it is an intuitive one. There are few road maps for measuring progress as with traditional computing. There is only the realization that sooner or later end-user computing will be the norm. User offices do not have to become involved today. But, as they become involved it is necessary to have the framework in place to support them. User offices recognize that end-user computing is their "initiative" requiring their commitment and their time and resources. The promise, for those that make the sacrifice, is a better organized, more efficient, more competitive organization; whether the organization is the University at large or one small department.

END-USER RESPONSIBILITY WITHIN INFORMATION PROCESSING SYSTEMS

Betty Marr Laster
Winthrop College
Rock Hill
South Carolina

Perhaps end-user involvement--or lack of it--has caused more grief in the realm of information processing than any other single issue. The advent of the micro and distributed processing has further complicated the problem. The organization's administration must accept its share of the responsibility for the problem, but data processing departments have been contributors also.

End-user responsibility cannot be established without consideration of the organizational structure itself. After this has been defined, there are at least five approaches to the use of information processing resources each with a unique list of responsibilities. The rules governing the end-users' responsibilities must then be drawn to fit the situation.

Today, society has at its disposal a vast array of technological devices. Newer and better concepts and ideas relative to technology are announced daily. In most professional periodicals, the thrust of the written word is on technology and, in between these pages of text, vendors display and extol the virtues of their latest products. These products are made to appear as the panacea for any given problem. Unsuspecting business persons are tempted to rush out and buy at once. Oddly enough, with all this commotion, technology is simply the vehicle by which information is gathered and disseminated. The need for gathering and disseminating information is the cause; the resulting technology is the effect. In this case the capability of the effect by far surpasses our ability as a society to use it for the cause.

Why have we not been able to exact from technology the full measure of its capability? This question of course can be applied in general terms referencing any technology, but let's define the scope of this discussion as "information technology."

Through empirical reasoning I conclude that we have failed to give due consideration to the human element involved. We have not concerned ourselves with the conditioning of the users--who, ironically, are the sole benefactors of technical innovations. As a direct result users seldom scratch the surface in respect to the effective, efficient use of technology.

Given this undesirable situation, who shall we say is responsible? Again, observation tells me the answer is twofold. First, as data processing professionals, generally speaking, we have alienated users through arrogance, lack of effective communication, and involvement with projects which consume inordinate amounts of time. We never seem to get anything done in accordance with our first projected time-frame. In fact it took me twenty years to figure out how to predict accurately the life of a project. This is arrived at by calculating how long it should actually take, multipying by two, and then raising to the next highest unit of measure. So a project which should logically take two months will take four years, . . . and so forth.

And then we have some users who must accept some of the responsibility. These are the users who are still looking for a button to press that will cause--through some miracle--the computer to regurgitate information to their exact specifications. The little device is expected to know, perhaps by osmosis, exactly what information is needed and in what format. These users have not even bothered to notice that we don't literally talk to computers. It will eventually come to that, but you can be sure it will have to be a structured coherent conversation.

So both the providers and the users have contributed to the problem. Succinctly restated, providers have failed to perform as intercompany team players and users have been reluctant to get involved. Together, these situations have rendered latent the use of information technology.

This is one of those problems which evolved, as opposed to being the result of capricious acts on the part of these groups. It probably originated in the fifties and sixties when anything accomplished by the computer was considered rather miraculous; so the users gazed in awe at some simple list that was shoved at them. Complain??? No. In those days analysts and programmers had the remainder of the work force so intimidated by the mere fact that they could "turn the computer on" that the users dared not question their logic. Further, the analysts conversed with top level management. Middle managers and those involved at the tactical or detail level never knew what to expect until they were the proud owners of a computer system. During that period user responsibility was confined to one phrase: "Learn to work with the new system or make a career decision!" Whether the system was effective or efficient was beside the point. Management had invested megabucks in this computer, and if it didn't work out it was not going to be the fault of management.

But along about the early seventies we finally caught on to the fact that that method wasn't working. The computer profession, therefore, set about to devise some structured plan which would "invite" the user to take part in his systems design. Books were written on the subject and ideas were tossed around for several years. In the meantime the technology was changing so rapidly that by the time we figured out the solution, the problem had changed. Users had found out about micros, personal computers and canned software, and they were charging off in all directions to buy these things to solve data problems that had seemed to bog down in the data processing department. I think that secretly we D.P.'ers were delighted because it got some users off our backs, at least until they began asking questions about tapping on to the mainframe. Technically speaking, this did not seem like a monumental request, but the associated management complexities were and still are there.

To even begin to alleviate this situation, it is imperative that these two groups--the user and the provider-- get organized in their efforts. The following is a systematic approach which is working for my organization, but first, allow me to define the "end-user."

The information processing end-user can be described in several ways. 1) A remote site connected via some communications method is a "user-site" with unique responsibilities. 2) Additionally, locally connected departments utilizing dumb terminals in an on-line environment are users. 3) Personal computer or micro owners, where the equipment is attached or unattached to the mainframe, are users. And finally, 4) some departments or locations have no equipment at all but receive services from the data processing department and they too are users.

The responsibilities associated with each of these conditions are so diverse they cannot be jointly addressed. The remote users' responsibilities historically have been defined more clearly than for any other group. This is especially true when the processing is inter-school. The rules governing the interface should clearly be spelled out via contract or written agreement. Such a contract should, at a minimum, address matters of: (1) equipment maintenance, (2) equipment expansion capabilty, (3) cost of services, (4) software maintenance, (5) schedule of services, (6) communications equipment trouble-shooting and maintenance.

In this definition of the user, there is less "grey area." Since there is usually a bit of money changing hands, rules are drawn to monitor the expenditure.

The remaining groups of users--locally connected--have responsibilities which to a large degree are common and can be jointly addressed. It is in these areas that user responsibilities have a tendency to be ill-defined and, as a result, they have been a source of contention, or in some cases all-out war, between data processing departments and using departments. So since the confusion over responsibilities seems to lie in the local site area, I want to direct this presentation to local-site situations.

The chart (Figure 1, page 3) is an attempt to depict the varying responsibilities of the end-user by situation. Essentially, the 1) type of organization, 2) method of use, and 3) type of equipment are the three determinants for the level of user involvement. Questions relative to each must be addressed before any procedures can be drawn delineating the required involvement of either data processing or using departments.

If we begin with the request for service and answer the basic questions, we will follow a path which leads to the appropriate rules governing each situation.

The first question should be, "Does your organization have an information center?" This will be determined mainly by the size of the organization or the level of reliance on computerized support. At this point at Winthrop we do not have one, although the reliance on computer support is fairly high. A modification to this concept is to provide micro-computer support only. This is what we are doing at Winthrop.

The term Information Center, or IC, was first used in the year 1976 by the IBM Canadian sales force. At that time it was being used as a selling tool for IBM equipment. When it moved into customer organizations, the term was used to describe a new DP/User liaison group originally intended to help both departments equally. It evolved to the current-day concept of being a distributed processing or micro support group, leaning more toward the user than to DP.

If you will permit me, I'd like to interject some personal opinion at this point which is absolutely free of charge. I feel that this profession--information center specialist--would not now exist if we as data processing professionals had been doing our jobs. The DP profession evolved as you know from the organizations' need to have someone speak in languages the computer understands. But over the years somehow a lot of us lost our ability to speak English, and as a result could not carry on a coherent conversation with a user. So information centers evolved to translate for us in the opposite direction--back to the humans. You don't have to be Phi Beta Kappa to conclude that obviously we converse with inanimate objects better than we converse with people. Some of us isolated ourselves into a world of bits, bytes, megabytes, gigabytes, not to mention MIPS, KOPS, EBCIDIC and ASCII, and we began to view the user as an annoyance which interfered with our drive to conquer the tools of the trade. Thus, the need for a USER LOBBY, so to speak. Well, so much for that.

If the IC exists in your organization, the interface at this point is between the user and the IC. If it does not exist, the request must be analyzed by the user and the DP department. At any rate, it is at this stage that the destiny of the request is determined.

LOGIC SCHEMATIC FOR DETERMINATION OF USER RESPONSIBILITY

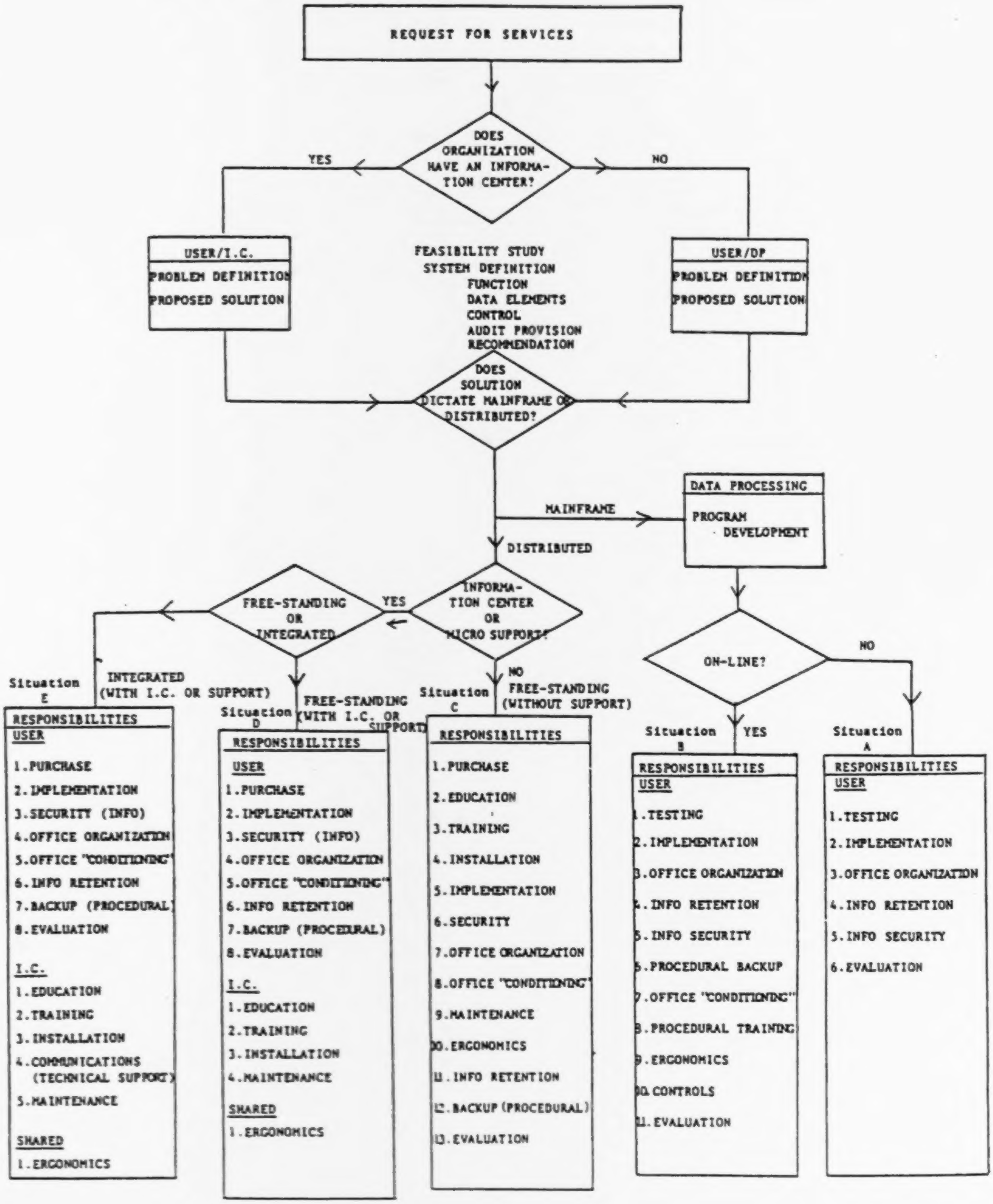

REQUEST FOR SERVICES
DOES ORGANIZATION HAVE AN INFORMATION CENTER?
YES
NO
USER/I.C.
PROBLEM DEFINITION
PROPOSED SOLUTION
FEASIBILITY STUDY
SYSTEM DEFINITION
FUNCTION
DATA ELEMENTS
CONTROL
AUDIT PROVISION
RECOMMENDATION
USER/DP
PROBLEM DEFINITION
PROPOSED SOLUTION
DOES SOLUTION DICTATE MAINFRAME OR DISTRIBUTED?
MAINFRAME
DATA PROCESSING
PROGRAM DEVELOPMENT
DISTRIBUTED
INFORMATION CENTER OR MICRO SUPPORT?
YES
FREE-STANDING OR INTEGRATED
NO
ON-LINE?
NO
YES
Situation E
INTEGRATED (WITH I.C. OR SUPPORT)
RESPONSIBILITIES
USER
1.PURCHASE
2.IMPLEMENTATION
3.SECURITY (INFO)
4.OFFICE ORGANIZATION
5.OFFICE "CONDITIONING"
6.INFO RETENTION
7.BACKUP (PROCEDURAL)
8.EVALUATION
I.C.
1.EDUCATION
2.TRAINING
3.INSTALLATION
4.COMMUNICATIONS (TECHNICAL SUPPORT)
5.MAINTENANCE
SHARED
1.ERGONOMICS
Situation D
FREE-STANDING (WITH I.C. OR SUPPORT)
RESPONSIBILITIES
USER
1.PURCHASE
2.IMPLEMENTATION
3.SECURITY (INFO)
4.OFFICE ORGANIZATION
5.OFFICE "CONDITIONING"
6.INFO RETENTION
7.BACKUP (PROCEDURAL)
8.EVALUATION
I.C.
1.EDUCATION
2.TRAINING
3.INSTALLATION
4.MAINTENANCE
SHARED
1.ERGONOMICS
Situation C
FREE-STANDING (WITHOUT SUPPORT)
RESPONSIBILITIES
1.PURCHASE
2.EDUCATION
3.TRAINING
4.INSTALLATION
5.IMPLEMENTATION
6.SECURITY
7.OFFICE ORGANIZATION
8.OFFICE "CONDITIONING"
9.MAINTENANCE
10.ERGONOMICS
11.INFO RETENTION
12.BACKUP (PROCEDURAL)
13.EVALUATION
Situation B
RESPONSIBILITIES
USER
1.TESTING
2.IMPLEMENTATION
3.OFFICE ORGANIZATION
4.INFO RETENTION
5.INFO SECURITY
6.PROCEDURAL BACKUP
7.OFFICE "CONDITIONING"
8.PROCEDURAL TRAINING
9.ERGONOMICS
10.CONTROLS
11.EVALUATION
Situation A
RESPONSIBILITIES
USER
1.TESTING
2.IMPLEMENTATION
3.OFFICE ORGANIZATION
4.INFO RETENTION
5.INFO SECURITY
6.EVALUATION

Figure 1

LOGIC SCHEMATIC FOR DETERMINATION OF USER RESPONSIBILITY

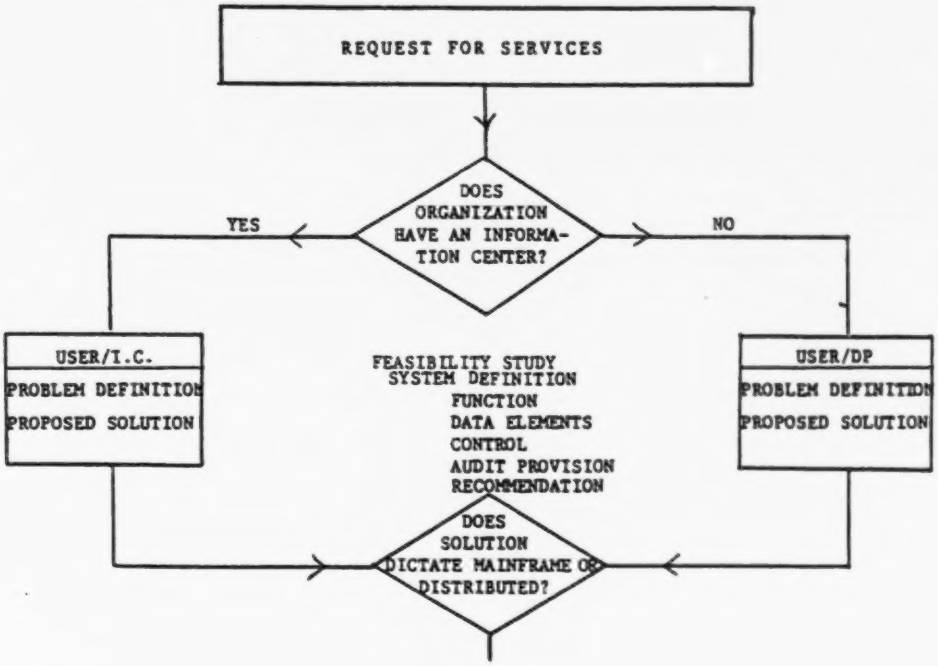

REQUEST FOR SERVICES
DOES ORGANIZATION HAVE AN INFORMATION CENTER?
YES
NO
USER/I.C.
PROBLEM DEFINITION
PROPOSED SOLUTION
FEASIBILITY STUDY
SYSTEM DEFINITION
FUNCTION
DATA ELEMENTS
CONTROL
AUDIT PROVISION
RECOMMENDATION
USER/DP
PROBLEM DEFINITION
PROPOSED SOLUTION
DOES SOLUTION DICTATE MAINFRAME OR DISTRIBUTED?

Figure 2

Within this area lies the first and most important of the user responsibilities (Figure 2). It is here that the problem should be accurately defined and a proposed solution drawn. For purposes of this presentation we should assume that this is a request for an application of automation, e. g., a Student Records System, a Purchasing System or Payroll System, as opposed to some small systems modification. The place to begin here is with a brief feasibility study which is devoid of preconceived notions. In this area one must get down to the basic questions: "Why does this department exist?" and "This department performs what functions?"

After the foregoing have been answered, the scope of the request begins to emerge. For data processors this is a phase that is prone to error. We have a tendency to limit the solution to a particular piece of hardware or software that is already in existence and to prematurely define the objective: e. g., "What kind of report do you want?" Or, "Of this data, what do you need to retain?" Forget the reports and the detail data right now and define the total objective. This is the reason some new systems are so hard to evaluate. No one seems to know or remember exactly what they were supposed to have accomplished in the first place.

Definition. This is the area that requires a lot of input from the user. The product of this process will determine 1) package or custom programs, 2) database or conventional files, or 3) distributed or mainframe processing. If the user is dealing with the DP department at this point he will, more times than not, believe that he must think and express himself like a DP professional, and this hampers his ability to communicate. (This hampers anybody's ability to communicate!) This is a totally false perception on the part of the user. How do you remedy it? Well, the user knows what his objective is. That's already been established in step one. Now, how would he accomplish this manually? "But this can't be done manually." Oh yes it can! It may take 500 people 18 hours a day seven days a week but it can be done manually. In fact, my observation is that in business processing, if it cannot be described from a manual standpoint, it is not a clearly defined project. Here the user should not be concerned in his description with duplication, extra data copies for multiple sequences or anything that smacks of inefficiency. Just describe the manual process. It will be the responsibility of the analyst or IC specialist to convert to the technical, explain the options and assist with the decision.

The database elements are important. The user has total responsibility in this area apart from record codes, keys and tracer numbers which will be a part of the technical process. The logical sequence of events to establish the database is:

1. Review the decisions to be made which were established in step 1. (System definition)

2. Review the function which must be performed - also covered in step 1. (System definition)

3. Compile a list of the information which is mandatory to accomplish these two steps.

4. Add information which would be desirable to have. On this list a user must be careful. Nothing should be on this list that does not have a maintenance method that is workable. Data that is not properly maintained is worse than absence of data. Let me share a simple form with you which should provide some direction in evaluating the user-proposed data. (Figure 3) The object is to have the user complete the form. The rationale is obvious.

DATA ELEMENT DETERMINATION					
Data Description	Data Name	Approximate Length	Source of Original Info	Maintenance Source	Responsible Position (For Maintenance)

Figure 3

Provision for control should come out of the design stage. (Figure 2) Control or balancing is a dual effort of the user and data processing; however, the control design is definitely the responsibility of the user. Data processing's contribution is purely technical. Control should serve to isolate processing into manageable units for problem resolution. Control should embody the best methods for error protection, not allowing the error to permeate the system.

Another step in the design stage is the audit trail development. This, too, is the responsibility of the user, since it is the user who must answer the questions of auditors. Basically, the audit trail should serve to prove that output is equal to input.

Now. WRITE IT DOWN!! COMMIT IT TO PAPER FOR FUTURE REFERENCE. This doesn't mean it is etched in stone. But it does mean that you will start out with an ORGANIZED effort.

Once this process is complete, responsibilities of both the user and data processing have been defined, tacitly at least. The outcome of the foregoing will enable DP to answer the next question. "Did this solution dictate mainframe or distributed processing?" (Figure 1) We will not address the issues involved with making this determination because that has nothing to do with user responsibility. In fact, an entire session would probably not be enough time to deal with the subject fairly. At any rate, depending on the answer to this question, the responsibilities vary.

If mainframe processing was the solution, we must further define the system as either on-line or batch. The two methods have differing user responsibilities. If we recommend distributed processing we have several other decisions to make. Do we have micro-support capability? Is the proposed system to be attached to the mainframe or is it to be free-standing? Each answer leads to a unique set of responsibilities. (Figure 1)

You will note that as the user's processing freedom increases so does his scope of responsibility. It's pretty simple for a user when the design is batch-oriented. It's a whole new ballgame when the user goes on-line. Further, when the micro enters the picture--without micro support in the organization--users bear the entire responsibility. IT IS NOTEWORTHY THAT THE CHOICE OF INTEGRATING A MICRO SHOULD NOT BE GIVEN WITHOUT A MICRO-SUPPORT GROUP.

SITUATION B

MAINFRAME SYSTEM
ON-LINE MODE

RESPONSIBILITIES

USER

1. TESTING
2. IMPLEMENTATION
3. OFFICE ORGANIZATION
4. INFO RETENTION
5. INFO SECURITY
6. PROCEDURAL BACKUP
7. OFFICE "CONDITIONING"
8. PROCEDURAL TRAINING
9. ERGONOMICS
10. CONTROLS
11. EVALUATION

SITUATION A

MAINFRAME SYSTEM
BATCH MODE

RESPONSIBILITIES

USER

1. TESTING
2. IMPLEMENTATION
3. OFFICE ORGANIZATION
4. INFO RETENTION
5. INFO SECURITY
6. EVALUATION

Figure 4

If we look at the mainframe solution first, we can see that the first six requirements are indigenous to both on-line and batch processing. If I may comment on my general experience, users are slack as a rule on items one through five. Users have an uncanny ability to stay on top of number six.

Let's take a closer look at situation A, which requires the least involvement. Whether it be with mock data or live data in parallel, the final testing of the system is the responsibility of the user who must provide the data and the action. Ideally, there should be plenty of time planned for the user to do this. In practice it does not always work that way because of timing constraints. An alternate method to use when parallel operation is not possible is to process a random sampling representative of a predetermined period of time. Prove the system by requesting that DP dump all files and print all reports so that they can be analyzed. Probably 95% of your problems will be located using this method, but you can count on the remaining 5% to surface right in the middle of your most critical period perhaps six months later. In any case the user must take whatever measures possible to test the outcome of the system. Only users are in a position to determine whether the system is functioning properly or not.

Implementation follows successful testing. The implementation date is determined by the user and must be closely monitored by the user.

Sometimes a new system or procedure will dictate a change in the organization of an office. In some cases this is not even thought about until the system is in use. As a result, sometimes an entire department is engaged in civil war. It is entirely up to the user to determine when position descriptions must be rewritten as a result of procedural changes or functional requirements.

The using department must be aware of records retention requirements and make a decision as to what should be retained on hard copy as well as magnetic media. This sounds elementary but in many cases magnetic retention is not mentioned until there is a need for "last year detail general ledger transactions." Likewise a written release of data tapes must come from the user when the data "dies," so to speak.

Security within a batch system requires the user to protect all hard copy data. Data processing ensures protection of magnetic media. But it gets a little more involved as we move to an on-line system. Let's skip the evaluation now and cover it with the on-line duties. (Figure 4)

Security, in an on-line or interactive mode of operation, is a very misunderstood area. For some reason there is a tendency to think of this in terms of internal security only. While this is mandatory to good programming policies and procedures, it is meant to be a "last resort" effort after all other security measures have failed. These other security measures are very basic and are the responsibility of the user. Simply sign off terminals not being used. Keyboard locks are there for a purpose. Passwords provide zero security when they are shared with others. Millions of dollars are spent each year in America on security software when just good common sense would cut down on violations by about 60%. Departments will be extremely lax about leaving terminals active when they would be appalled at a file drawer left open. There is no difference except in the format of the information. All it takes is a little motivation on the part of someone inside or outside of your organization and you have the potential for a problem.

Backup is extremely important. Plan B should be ready to bring into play as soon as it's determined that an on-line system is going to be down for a while. This type of backup (procedural) is the total responsibility of the user. Now it may be that some sort of listing will be needed on a regularly scheduled basis. The user must communicate to the data processing staff what is needed to be able to carry on in circumstances such as the described.

Disaster backup of course is the responsibility of data processing. This is, among other measures, retention of files, off-site file storage, off-site recovery plans, etc.

One of the most important aspects of new systems installation is what I call office "conditioning." This appears in quotes because it is intangible. It has to do with the mental acceptance of a new method or procedure. It actually goes along with office organization which we discussed relative to batch systems, except that in a batch system employees do not tend to get as "bent out of shape" because their routines are not as upset.

The user department head must determine whether the inputs or outputs of the new system will require more or less manpower. If more manpower is the case, long before the system is implemented a clearly defined position description should be drawn. Any organizational changes should be well described to and understood by any current staff members. If this is handled correctly, the computer system becomes the object to blame for the confusion. This kind of error will ensure dissatisfaction with the new system. I have witnessed total disruption of an entire office's activities over the placement or location of a printer. It is the responsibility of the user department head to condition the minds of the staff to the new method or procedure.

How about procedural training? All too often employees of other departments call data processing to ask how to perform a particular function or how to process an unusual transaction. This should never happen. The department head should have written the procedures for each function in his/her area whether they are computerized or not. It is ludicrous to assume that merely changing the tools used to perform the task should make another department responsible for procedural guidance. The department head may want to ask the DP department to assist with employees' technical training sessions, but the ultimate responsibility lies with the user.

A lot has been said about ergonomics. I think it was the "word of the year" last year. The year prior to that, it was "synergy." Remember that one? In essence, ergonomics is the most optimum blend of quality, production and comfort. User involvement here should include all decisions in regard to equipment location, desk arrangement and height, office chair selection, lighting, etc. A terminal selection, where possible, should include a tilt-base, an adjustable keyboard, and a non-glare screen.

In an on-line system, since there is no manual intervention between the data origination and data processing, all the input control must be the responsibility of the originators. Certain checks can be automated such as monetary field limits, checking for proper data-type and so forth, but the responsibility for establishing such checks is still the responsibility of the user. The computer cannot possibly know limits unless they are conveyed formally to the processing center. Raw data control should at a minimum prove that what was entered was in fact successfully recorded and that there were no illegal entries. Proper handling of the documents used for input and some sort of computerized transaction listing would satisfy this requirement.

After the system has been in use for several months, the user and data processing should critique the system. You can see by this time that this system is not going to be viewed by the user as "the crummy mess that data processing dumped on us." If these procedures have been followed, the user has a stake in the development, too. This allows for total objectivity in the critique because the emotional issues are not present. Now the two departments can expend energy resourcefully.

SITUATION E

INTEGRATED MICRO OR DISTRIBUTED SYSTEM WITH I.C. OR MICRO SUPPORT

RESPONSIBILITIES

USER

1. PURCHASE
2. IMPLEMENTATION
3. SECURITY (INFO)
4. OFFICE ORGANIZATION
5. OFFICE "CONDITIONING"
6. INFO RETENTION
7. BACKUP (PROCEDURAL)
8. EVALUATION

I.C.

1. EDUCATION
2. TRAINING
3. INSTALLATION
4. COMMUNICATIONS (TECHNICAL SUPPORT)
5. MAINTENANCE

SHARED

1. ERGONOMICS

SITUATION D

DISTRIBUTED OR MICRO FREE-STANDING SYSTEM WITH I.C. OR MICRO SUPPORT

RESPONSIBILITIES

USER

1. PURCHASE
2. IMPLEMENTATION
3. SECURITY (INFO)
4. OFFICE ORGANIZATION
5. OFFICE "CONDITIONING"
6. INFO RETENTION
7. BACKUP (PROCEDURAL)
8. EVALUATION

I.C.

1. EDUCATION
2. TRAINING
3. INSTALLATION
4. MAINTENANCE

SHARED

1. ERGONOMICS

SITUATION C

MICRO OR DISTRIBUTED FREE-STANDING SYSTEM WITHOUT I.C. OR MICRO SUPPORT

RESPONSIBILITIES

USER

1. PURCHASE
2. EDUCATION
3. TRAINING
4. INSTALLATION
5. IMPLEMENTATION
6. SECURITY
7. OFFICE ORGANIZATION
8. OFFICE "CONDITIONING"
9. MAINTENANCE
10. ERGONOMICS
11. INFO RETENTION
12. BACKUP PROCEDURAL
13. EVALUATION

Figure 5

When micro-computers entered the scene (Figure 5) the responsibility issue became even more complex. I think the typical approach was for D.P. to ignore PC's and maybe they would go away. So we did and they did not. Their existence in the organization created an entirely new set of problems. One of the reasons should be apparent just by viewing the chart. (Figure 1) Back in round one the feasibility dialogue should have taken place between the user and DP as indicated. (Remember, we are looking at PC's without micro-support or an IC--Situation C--so the dialogue had to be between the user and DP.) If in fact the problem could be solved by the use of a micro, it should have been recommended by DP, who at that point would have known that the user did not need the corporate database and that a PC package would do the job. THE PROBLEM WAS THAT THIS FIRST DIALOGUE NEVER TOOK PLACE. So this entire portion of the procedure was circumvented and a PC showed up in a user office. In some cases it sat there for weeks because what was sold to them as "friendly" and "easy" turned out to require a little more than a power outlet. Now the next thing that happened was that the user began to ask questions about tapping the organization's database. In the absence of organized micro-support this cannot be done without jeopardizing security. The potential for releasing data without authorization is great.

So when we follow this path and select a micro, the user must assume these responsibilities or he/she is going to be very unhappy with the situation. As you can see, there is some commonality with the previous lists, but we've added PURCHASE, EDUCATION, TRAINING (technical as well as procedural), INSTALLATION, and MAINTENANCE (hardware and software).

If the situation is free-standing with IC or micro support, the user gets some relief, and the four added responsibilities default to the IC or support group. Ergonomics should be a shared responsibility based on expertise of the support group and a final decision by the user.

Learning a software package is time-consuming, as end-users have found out. That is why I would recommend standardization if a micro-support facility exists. It's impossible for even this group to have a good working knowledge of all the packages that exist at Winthrop, for instance. It would seem to me that three packages each of the popular office automation series would be sufficient for most operations. There will always be "non-standard" situations which need "non-standard" solutions, but if this schematic is followed, the IC is well aware of what is needed and is prepared to deal with any deviations from the norm.

When the micro needs to be attached to the mainframe, we have a new responsibility for the IC or support group. The communications problems must be addressed. These can be technical problems or software problems brought about by the need to convert data from one format to the other. Again, the user is aided to a great degree by the IC or micro-support and, as in situation D, ergonomics is a shared responsibility.

In summary, (Figure 1) end-user responsibility cannot be established without consideration of the very organizational structure itself, and the establishment or avoidance of an IC or micro-support must be an administrative decision. Next, through a joint effort of the appropriate DP group and the user, the technology is selected which best achieves the objective. The rules governing the responsibilities of both provider and user are then determined by the resulting situation.

Foundations for Success: Creating a Working Partnership with your EDP Auditor

by
Pamela Clem, Assistant Manager, EDP Audits
and
Mark Olson, Director, User Coordination, Student Information Systems

University of Southern California
Los Angeles, California 90089

Introduction

The Cause '86 National Conference theme, "The Impact of Converging Information Technologies", encourages us to consider the impacts, the effects, of the dramatic convergence of systems advances and technological accomplishments we've seen in the past few years. This paper and the arguments we propose, result from such a consideration, for the authors find themselves working on a project that was born of this same system advance and technological growth. As we use fourth generation system development tools, new application design equipment, and the latest advances in communications technology, we feel their impact in many ways. With data base design "on the fly" and screen mock-ups at the fingertips (ours and the users!), traditional design models fail to account for the dramatic impact these tools have on the design and development project. Development calendars are literally cut in half, and application programs are prototyped often before their functions are articulated entirely! There are many impacts of this technology and our focus here will be directly on the role of the EDP Auditor and the Systems Development Team during an 18 month project to design, code, test, convert and install a comprehensive integrated Student Information System. We will suggest that with this convergence of technology those involved in systems development must develop close partnerships to form a basis for success in their efforts.

In the May, 1986 issue of CAUSE/EFFECT, George Carroll, the director of the Center for Computer and Management Services at Rutgers, presented an argument for teamwork with EDP Auditing: "Computer center managers should view EDP auditors as allies who can help them manage more effectively, especially in the area of security. The audit function and computing management share the objective of fostering a reliable, secure data center." We are extending Mr. Carroll's argument to address system development and audit's role in this function as well.

The Context

A word about the context of this project: In the summer of 1985, the administration of the University of Southern California made a key decision: all administrative computing applications would migrate from the IBM mainframe environment to a PR1ME Computer environment.

The university had experienced great success with the in-house development of a financial accounting system and a budget administration system on PR1ME, and it was decided that the remaining administrative systems would be well served on the PR1ME 9955 computers. These systems include: Payroll and Personnel; Alumni/Donor (University Relations); and Student Systems. Our focus is on the Student System development project, which formally began in November of 1985. The SIS (Student Information System) includes four primary student administrative applications: Admissions; Financial Aid; Registration & Records; and Bursar Operations. These applications will run on three PR1ME 9955 super-mini computers linked together with PR1ME's sophisticated network communications architecture. The SIS supports a student enrollment of about 27,000 FTE, including undergraduate, graduate and professional students. The development team was given a mandate to bring up a functional base system by June of 1987.

The SIS development team consists of a project director, four project leaders, one for each of the primary system areas, six full time programmer analysts, two part time student programmers, a three member User Coordination Group, and an administrative assistant. The User Coordination Group, UCG, is responsible for ensuring that the system meets user expectations, that the user community is closely involved in the design and development of their system, and that they are trained in the use of the system when it is installed. It is through this group that the partnership with the EDP Auditor was founded and through which the working relationship described below is maintained. As of this writing, the project is on target and has been fully supported by the user community. The success to date is due in part, we feel, to the working partnership established between the development team and the EDP Auditor.

When the SIS development project began, the University Bursar was asked to oversee the entire effort, being "loaned" from the Financial Services Office for the 18 month project. As well, the director of the User Coordination Group was borrowed from the Admissions and Financial Aid Office where he directed a distributed computing resource center. It is important to note that this sharing of resources epitomizes the university's approach to this system development effort. The shared positions are a result of the school's desire to ensure user participation, cooperation, and dedication. Ultimately, the expectation is that through close working relationships, we will deliver a system that functions well and meets user expectations. The partnership with the EDP Auditor is grounded in the very same presuppositions as those underlying the intimate user involvement in the development project.

Our EDP auditor, and most with whom I am familiar, has a background in data processing, systems analysis, and programming. From the beginning of the project, we approached the development effort as a team. Early on we addressed the part that the auditor would play, and agreed that hers would not be a passive, "look over the shoulder" inspector role, rather her role would be based on participative involvement. Here was another resource in an environment of very scarce resources. We were setting out on an 18 month project with few experienced PR1ME programmers, a new development tool, and a skeptical user population. It was clear to us that we should take full advantage of any resources available. So from the very outset, our EDP Auditor was seen as a resource, a willing supporter and participant in an ambitious project. And we discussed our partnership in these very terms, directly, openly, and candidly. Today, we can look back and reflect on the wisdom of those direct and open discussions, for we have worked well together knowing the roles we were to play. Our auditor was going to be a resource, not a rat -- a supporter, not a spy.

As indicated earlier, our systems development effort is taking place in the midst of a convergence of technological advances, most specifically in terms of software development tools. We are using an advanced, fourth-generation development tool, called TOADS (Total On-Line Application Development System) which has dramatically changed our development approach. In brief, we are using an iterative prototyping method that produces startling results, and in remarkable time frames. We minimize front-end design documentation and specification, and begin with functional specs that quickly produce data base designs and transactions with fully operational screens in a very abbreviated amount of time. This approach is guaranteed to trouble EDP auditors! It was clear that we needed to involve our auditor if for no other reason than to ensure her familiarity and comfort with this fast, iterative, prototyping approach to systems design and development. Our partnership secured her involvement, support, and understanding, as the following discussion will reveal.

The Partnership from the Auditor's Perspective

The internal audit department at USC consists of nine staff persons. Of that number, there is one administrative assistant, a director, a manager, three senior auditors, two auditors, and me, assistant manager of EDP audits. In spite of the title, no one reports to me and for all intents and purposes, I am EDP Audit at USC. On occasion, however, my colleagues and I work on projects together. At this time, I should point out that ultimately both the systems development director and I report to the same person, the senior vice president of administration. Our EDP Audit responsibilities fall into three major areas:

1) Data Center Reviews - there are two major data centers and several smaller centers at the university.

2) Application Systems Reviews - as in any organization, we have payroll, accounts payable, and similar systems. Of course, as in all universities and colleges, we also have student systems which need to be audited.

3) Systems Development

It is under the third area that my involvement with my colleague Mark Olson, and the Student Information System lies.

An auditor's role, very broadly speaking, is to ensure that people and systems are functioning properly, efficiently, and in a control-conscious environment. In a systems development audit, an auditor has continuing involvement throughout the systems development life cycle.

The life cycle of a system starts with an accepted idea and continues through the following phases:

- General system design and hardware selection
- Detailed system specifications
- Programming and testing
- System testing
- Conversion
- System acceptance and user approval
- System maintenance

Of course, throughout the system development life cycle, the documentation of each phase plays an extremely important role.

My involvement with the SIS development team began shortly after I joined the University in late 1985. There was support for audit participation from both my management and the project management. Having previously audited several developing projects at other organizations, as well as having been a systems analyst, I knew what to expect in a development effort and how I wanted to impact the project. This was the first time, however, that I was to be involved with a fourth-generation tool and the speedy prototyping that it allowed.

"But what exactly is the role of an EDP auditor in systems development?", other team members were surely asking themselves. Mark humorously suggested in our initial abstract, "The EDP Auditor: Resource or Spy?" My idea had been "resource or rat," but seriously, should an EDP auditor function as a watchdog, an advisor, consultant, designer, analyst, a little bit of each, or none of the above? We tend to think that the auditor is a little bit of each, and, depending on the project, and the talents of the auditor, the mix of functions can change although the auditor has to be careful to keep his or her independence. In an organization with several EDP auditors, independence can be achieved by having one auditor involved with the development process while another audits the system following implementation. At USC, independence will be achieved by having a non-EDP auditor perform the post-implementation audit.

My involvement with the student system began after the decision had already been made to go ahead with the system and to do it on PR1ME computers. Thus, audit had no input as to whether moving from an IBM to a PR1ME environment was advantageous for the University. Having seen similar moves from IBM to smaller systems both fail and succeed, with individuals in both camps chortling, "I told you so", I was able to remain impartial even though recognizing the heavy bias towards the PR1ME environment. Although I was supposed to be a full-fledged member of the project team, I do not think I was viewed as such by management until approximately three months later. I did not attend meetings, for example, in which policies and systems requirements were discussed with the user groups. That is not to say that the exclusion was an intentional slight or lack of support on management's behalf -

it instead reflected a lack of understanding of what the auditor's role could and should be.

Which brings up the subject of problems that auditors can and do face when attempting to become part of the systems development team.

1) Politics and personalities

Some departments and users don't want to be under the scrutiny of an auditor nor do they feel that an auditor should be involved in a system that hasn't even been implemented. Usually, it is very easy to convince the doubters that the proverbial stitch in time saves nine, or in other words, controls designed into the system are cheaper than implementing them after the fact.

2) Time constraints - other job responsibilities and
not being a full-time project team member.

These items have been lumped together because they all have to do with the time factor. As mentioned previously, being the only EDP auditor at USC means working on several projects concurrently. In the ideal world, there would be two or three other EDP auditors at USC allowing me to devote more time to one project. However, many do not see audit participation on a development project as a full-time or even 50% proposition. While that is not the case at USC, the amount of audit participation in each project depends on the nature of the system and the audit department's budget.

3) Lack of expertise in all areas

I think it can be safely stated that most EDP auditors are the equivalent of the medical world's general practitioners - we're jacks of all trades and while we can be masters of some, it is unusual to be masters of all. So, just as a GP could not be expected to be both a brilliant brain surgeon as well as a sought-after cardiologist, neither should an EDP auditor be expected to be an expert in all areas of data processing, including hardware, operating systems, programming, systems analysis, networks, etc. as well as the application areas to be audited. This was my first foray into PR1ME time, for example, making me necessarily less effective than had the move been made to an IBM environment where I have had more experience.

4) Lack of controls in other areas

A system can have every possible control designed into it and still fail when implemented. The system is not an island unto itself - it operates hand in hand with its data center and with the users in the applications area. Control weaknesses existing in either area can cause "the system" to fail. Indeed, we are planning a follow-up audit of our PR1ME data center to ascertain that its procedures are adequate to support the student systems and all others processed there. Our audit program will focus on all data center functions which naturally impact the smooth processing of any system including physical security of the data center, backup procedures, disaster recovery, development standards, etc. A follow-up audit of the PR1ME center was scheduled for "sometime" in the future. However, we felt that with two major systems having been implemented in the past year, in this case payroll and personnel, and alumni donor, and with the major addition of the student system over the course of the next year, it would be advantageous for audit to move up its planned coverage. In this way, we will ascertain whether or not the system will be operating in a control conscious environment.

How has EDP audit impacted the student information system project? Certainly, the addition of an auditor to the development team is in itself a statement of management support for developing an efficient, controlled system that will satisfy user expectations. Whether this support is consciously or subconsciously perceived by the development team and users is really not important. What is important is that it's there. Secondly, it has provided the team and users with an independent sounding board to whom they can express hopes, and frustrations. Thirdly, at the beginning of the project, a checklist was given to the team to state what we as EDP audit expected in a development effort in terms of deliverables, documentation, testing, security, etc. This in turn has led to testing screens as they become available, reviewing documentation and timetables, and, as previously mentioned, a planned audit of the PR1ME data center. Finally, we have laid the groundwork for more complete audits of both the student information system and the relevant user areas in the future.

From the standpoint of audit documentation, the most important thing to remember is to keep everything produced by the project team. Well, perhaps for audit purposes, that is a bit too much. What we have done is to keep a chronological file of all memos, file descriptions, systems overviews, and user documentation that have been distributed. In addition, the results of all tests performed on the system have been filed into workpapers. After a problem has been encountered and discussed with the appropriate project team member, a tickler file is set up to ensure that the error has been corrected.

It is hoped that with the majority of other projects put to rest, more time will be available to spend on the student system. Time will also be dedicated to an in-depth study of TOADS, the advanced, fourth-generation development tool which has so impacted the development process. This will, of course, assist us in the audit of systems to be developed on the PR1MEs in the future.

Approximately six months following implementation of the final segment of the SIS, or two years after Day 1 of the project, internal audit will begin auditing the systems in their respective user areas. The insight my fellow auditors will gain from our participation in the development will facilitate their reviews, and hopefully shorten the number of budgeted hours per audit.

Tying in the theme of "the impact of converging technologies" to EDP audit participation in development projects, it can certainly be stated that we are as constantly impacted by the converging technologies as are our colleagues in the data processing world. At USC, this impact is manifested in the willingness of a project team and audit department to share their expertise and resources in order to develop a student system second to none.

With thorough and comprehensive attention to the many phases of a design and development effort, we feel the partnership has enabled us to build a solid foundation for the new SIS. The Internal Audit Department feels very positive about the design, security, and control issues being addressed in the system, because we have in fact participated in the development effort as a team member.

The Partnership from the System Development Director's Perspective

The "success" we refer to in the title of our presentation has a specific meaning in this context. We will succeed only if the SIS project provides a fully functional, integrated, base system within our 18 month timetable. The system must be a responsive, reliable, and secure application solution to our user information processing needs and expectations. We refer to "foundations" in the title because only those are in place today, though certainly more than half the project is completed. Only when it is finished will we be able to know whether we've succeeded or not. The final success will rest on the systems' security, reliability, efficiency, and integrity, and on the user community's acceptance and support. From my perspective, faced with limited technical resources, and charged with securing user support, gaining EDP audit endorsement was a key step. Gaining EDP technical work and review was a coup!

If the users are aware that the systems development group meets every other week with the EDP auditor, and that the auditor attends all key committee meetings, they gain a confidence in the project. I look at the "image" issues along with the technical ones, and have learned that the user community takes comfort in knowing that the audit office is closely involved in the development work. Perceptions cannot be ignored, and we have built an open and responsive system development atmosphere that carefully keeps the users informed and close to the project. Their sense of our professional pride and integrity has given even them a belief that we can accomplish our ambitious goal, that we'll succeed. We doubt we'll succeed if we don't have this belief well secured, this foundation laid.

Particular examples of the auditor's work on the project should provide both specificity and direction for others attempting to build partnerships with auditors. When application functions are first requested by the user representatives, the User Coordination Group provides quick write-ups and documentation that takes varying shapes. Sometimes notes and questions resulting from a meeting form the first design documents. Whatever the case, we place a premium on quick response time with notes and minutes to meetings, with our write-ups of what we think we're hearing the users asking for. We in turn expect quick response from the users, and in very little time, we are looking at screen prototypes and transaction processes that manipulate test data. The processes are documented with fairly formal "process overviews" that describe their functionality and use, and put on test system menus that are accessed by the users and the EDP Auditor. Through frequent meetings with the auditor, we review these processes as they move through the test stages.

The TOADS development tool provides menu-driven transactions to display various test screens as they are being developed. We have given our auditor an account on the test computer, with access to all of the test systems. Regularly, she logs onto the system and reviews the prototype screens and transactions as they are being built. Often our meetings will address issues raised when these test screens were reviewed. Should changes be necessary, we review them with the primary user representatives, and implement them accordingly. The iterative development process includes the auditor in the loop.

System and user documentation must be audited in this development process as well, and we have made this one of our specific tasks in the project. As our processes go into the test system, they are accompanied by on-line help documentation designed to provide user support and assistance. The auditor reviews these help documents to ensure that they provide clear, direct, and succinct support for the processes documented. Process overviews and other technical documents are also reviewed on a regular basis. In many ways, our auditor is our "test" audience for the written documentation, and we depend upon her ability to understand and approve the language and terms used in the documentation. Her comments inform later efforts at these system narratives.

A major area of concern at USC, and certainly all schools, centers on the security systems protecting the data base, and restraining access to the files. We rely on our EDP auditor to review our data security approaches, as well as the physical security aspects of the center. We ask our auditor to help us find "holes" in the security, and with her background in computing, she has proven to be very successful at finding logical and technical weaknesses in the system. As these are encountered, they are documented, logged, and addressed. Some months ago, we found just how valuable this "silent" audit is: one of the key system menus included a sub-menu for initiating batch processing. We did not realize that the sub-menu options were not properly tied to the security system, and only through our auditor's review did we catch the error. (The project leader for the bursar's system was glad we caught it too, as we might have run a month-end process in the middle of the month!) So our auditor is working on the SIS project even when she's not in a meeting with us and the users.

Credibility during the development process comes from only a few sources, from users experiencing prompt response to their expressed needs, and from users getting what they ask for. We've mentioned that we put a premium on getting quick turnaround on system documentation, process prototypes, and other user requests. We can only keep credibility when we can demonstrate that we meet the dates scheduled on our master development calendar, and here again our EDP Auditor plays a key role. Our auditor makes it her job to inquire as to the status of projects on the calendar, and she insists that we notify her of any changes or updates to this document. As a partner in the project, she is as concerned as the rest of the development group that we hit the deadlines and delivery dates scheduled on the calendar. To date, we've been meeting these dates, and credit does go to our auditor for her assistance in reminding us of our commitments. One reward is a strong credibility level amongst our user population.

Finally, it was important for our entire project to support our partnership with EDP Audit. Our mechanism for accomplishing this goal was through direct communication between the design and programming staff, the User Coordination Group, and the user community, and the EDP Auditor. Again, meetings with the entire staff help here, but the most success came from another source. With the shared development systems, and the ease of reviewing screens and transactions in progress, our auditor has been able to stay current on the design progress, and to review screens in a timely and cooperative manner. The analysts have come to see the auditor as one more "pair of eyes" to look for bugs and to test functionality. Indeed, after the initial hesitancy on the part of the programming staff, we've experienced a climate of cooperation and enthusiastic sharing of code, screens, and ideas on solutions to specific problems.

Conclusion

We have attempted to describe our approach to building a working team of the EDP Auditor and the System Development group. Through regularly scheduled meetings we build user credibility and ensure teamwork. Through careful audit review of system transactions we gain additional resources and technical analysis support during the development process, not after the fact. With security scrutiny we ensure the integrity of the system, and with calendar monitoring we assure timely delivery of system modules. And with coordination and cooperation between audit and the programmers and analysts, we truly build a foundation for teamwork.

We are very sensitive to issues of a political nature and we attack them directly, with candor and open communication. We recognize our limited resources and the constraints of time, and through such awareness are better able to accomplish our goals. We document and record our activities and thus can review and evaluate our progress, making adjustments where necessary, as we proceed with the project. As George Carroll commented, "an open, honest approach will serve best in the long run because in an audit situation it is vital to maintain credibility." We have gained a high level of credibility, and that belief and support, from both the users and the development staff, are fundamental to the success of our endeavour.

A MODEL FOR MANDATING TRAINING POLICY CHANGES

by

Anne Woodsworth
University of Pittsburgh
Pittsburgh, PA

and

James F. Williams, II
Wayne State University
Detroit, MI

ABSTRACT

The application of electronic technology to library operations over the past fifteen years has heightened the frequency of change at exponential rates. There are more innovations which are introduced and which must be accepted within institutions. This environment raises new expectations and new needs in personnel management -- including but not limited to, a redesign of the kind and content of existing staff development programs to ensure skill and competency in new technological applications. The escalated rate of change requires a corresponding change in staff training and retraining, oriented away from individual needs and towards institutional need. One solution is proposed which demands top administrative support and routinization of innovations.

A MODEL FOR MANDATING TRAINING POLICY CHANGES

> The rapid growth of electronic technology in the past two decades presents universities with the first major transformation in the transmission and storage of ideas and information since the introduction of printing in fifteenth-century Italy and Germany. It is an absolutely shattering development, requiring rethinking for nearly every aspect of higher education (1).

From the perspective of almost any type or part of a college or university in North America, Keller is highly accurate. Further, there is general acceptance of Naisbitt's declarations in 1984 that (i) the industrial age has ended, (ii) the information age has begun and (iii) industrial commodities have been surpassed by information as the nation's number one product (2).

As a result of this new emphasis, managers of major responsibility centers can anticipate new, greater, and different demands at their institutions for rapid access to information; demands which heretofore, did not exceed the ability of the institution to respond. With the application of information control technology however, constant change has been introduced as a more significant factor in the management equation. To illustrate, it has been said that if we could define a "unit of change" and then measure how long it takes for that unit to occur, we would find that in 1900 it took ten years; in 1950, one year; in 1970, one month; and in 1980, only one day for that same unit of change to occur (3). Although our experience has been with libraries in particular, the present influx of on-line systems for organizing, storing and disseminating information is no longer unique in universities. In almost every responsibility center the present emphasis on introducing technology is but a precursor for continuing change in procedures, systems and services. While the experiences and the model presented here are derived primarily from libraries, it is applicable to any responsibility center in a college or univerisity that is undergoing rapid technological change.

The Pace of Change

Librarians and other information specialists may look upon the present as turbulent technological times - times when it is admittedly difficult to maintain one's bearings, make decisions, and manage. While it may appear that technological evolution is more rapid today than in the past, an historical perspective indicates that change always comes about in dramatic bursts (4). It is also comforting to know that bursts of change in a given area generally run their course in approximately 50 years, followed by a period of stability. If this theory holds for libraries, the beginning of the next century should see a more stable state for the most advanced information systems. Drucker notes that particularly long lead times are required when innovation is knowledge-based and depends on many kinds of knowledge (5). If and when an application transcends this period, it becomes a paradigm that captures the essence of the technology and provides a sound solution to the problem it originally addressed. If, therefore, innovation and change can be shown to follow relatively predictable patterns, it is possible to establish reliable bearings on the present and to manage the future (6). Prediction, then, should serve as a critical aid to library management. Further, library management should place more emphasis on recognizing that:

1. Any new information systems product takes time to engineer, and if managers are attentive and looking in the right direction, there is sufficient time to prepare staff and plan operations for technology under development;
2. New, successful information control innovations will become more predictable; and
3. Paradigms should be watched for and identified, as they signal the turning point towards stability.

The Current Environment

Large library systems are labor intensive and it is the staff (clerical, technical and professional) in these organizations who are headed into an era of evolutionary changes in their work place (6). Over the past fifteen years a large number of libraries have had a taste of innovative technological changes in information systems, mostly through (i) coin operated copying machines, (ii) devices for facsimile transmission, (iii) systems for digital image enhancement, (iv) electronic databases, (v) online catalogs, (vi) disk oriented image storage and retrieval, (vii) multimedia learning systems, and (viii) microcomputers with telecommunications capacity. Because these changes were introduced relatively slowly, a library's staff was able to adapt and learn new systems at a fairly leisurely pace. Those staff members who could not be trained to use these systems could usually be accommodated elsewhere in the library, with jobs that were less technologically dependent.

The future will probably not permit libraries the luxury of having staff who cannot use new technology effectively. At the same time, libraries will be concentrating on preserving the traditional parts of their collections, while adapting to a quicker rate of change in new information systems. With microcomputers, electronic publishing, compact disk technology, and videotext technology emerging in the information business at the same time that libraries are installing fully integrated on-line systems, it is easy to foresee that the rate of change in library operations will escalate. Thus, work-flow, assignments, and organizational structures in libraries have already begun to alter with increasing frequency. As a result, staff will need to be trained and retrained more often than ever before.

Staff Development and Training

By most standard definitions, staff development is oriented to on-the-job performance. Its goal is to improve the performance of both the individual and the institution, and it is typically viewed as obligatory on the part of the institution. Continuing education/professional development, on the other hand, places more emphasis on an individual's personal and professional growth rather than on job skills. It is therefore viewed as an activity requiring only partial institutional support. While libraries have paid some attention to the need for staff development and training in the past, it has mostly been from the perspective of an individual's development, and not from the point of view of the library organization and its future requirements. In future the latter must be given considerably more emphasis.

Ideally, staff development and training should be a systematic attempt to harmonize individuals' interests and wishes with the forthcoming requirements of the institution in which they work (7). In the early seventies, Kaser noted that "There has... been practically no literature, and apparently only limited recognition of the desirability of such a systemic approach to the problem in America's large libraries" (8). Ten years later only modest gains appear to have been made according to a 1982 survey by the Association of Research Libraries (9). Although libraries and their parent institutions were assuming greater responsibility for planning, encouraging and facilitating programs, most of the efforts appeared to focus on individual opportunities, rather than total organizational requirements. Most also still appeared to be addressing only continuing educational opportunities for individual growth, lacking a framework for growth and the most efficient use of institutional resources to meet organizational needs.

Obviously then, there has long been a need for libraries to take a more systematic approach to staff development and training according to expert observers of the field. With automation and new technology touching every aspect of the operation of large libraries, the need for improvements in staff development and training has become even more critical.

Increased Necessity for Staff Development and Training

The automation of library operations through the use of new technologies is forcing libraries through a period of turbulent change. The resulting organizational and operational changes, such as new staffing patterns and growing pressure to improve productivity, are primarily responsible for the current need to extend staff knowledge and skills. Recent forecasts related to office automation reveal that:

1. Managerial, sales, and technical/professional jobs of the future will require significantly different skills from those of today, and totally new jobs will be created;

2. The capabilities of office work stations by the year 2000 will include voice input, access to a multiplicity of remote data sources, and the ability to serve as personal filing systems;

3. The smaller number of clerical jobs ... in the year 2000 will demand considerably broader responsibilities and will require substantially greater skills in clerical jobs ... (10).

While libraries are still seeking a paradigm in terms of providing access to information, it will probably be a user's work-station similar to the one mentioned above. It is commonly envisioned that a scholar's work-station will be one that (i) allows access to the scholarly record regardless of location, (ii) allows manipulation of data from various databases, (iii) follows a single set of user protocols, and (iv) contains an operating system with sufficient intelligence to improve on its own performance. This paradigm will free librarians and paraprofessionals to turn their attention to: the kind and content of the full range of service capabilities made possible by the paradigm; the management of a knowledge-based information service; enhancements in service; and enhancements to the paradigm, including new requirements for systems organization and management.

Given predictions that users' foci and expertise will still be narrow and restricted to a single area of study (albeit an interdisciplinary one), librarians will be expected to be able to organize diverse data files in customized fashion, using criteria dependent upon abstraction and analogy. The technology will provide endless capabilities that demand these new skill levels. It will, in many cases, also be in the process of teaching new skills, as public access microcomputers, for example, are used in computer-assisted instruction.

Without a means to maintain staff competency in this environment, a library cannot achieve its mission nor can it keep staff satisfied with their work. Staff development and training will increasingly have to be seen as one of the vehicles to overcome resistance to inevitable change.

In the early seventies the factors that had emerged as pointing to the need for more effort in staff development and training included economic constraints accompanied by decreases in staff in libraries, by the emergence of management theory that emphasized its cost-effectiveness, and by the growth of opportunities for continuing education. More recently, the lack of mobility in a tight job market has further stimulated the need for libraries to ensure the continuing evolution of new skills in their staff - skills that normally would otherwise come to an organization through new hires (11).

A Suggested Solution

There do not appear to be any ready-made formulae available for the development of a systematic staff development and training program in a large research library. However, a study of the life history of innovations by Yin (12) demonstrated that four key internal conditions to innovations becoming routinized are: specific support of the top administration in an agency; training practitioners to use the innovation as frequently as possible; ensuring that the innovation displaces an old practice; and having the innovation operate effectively. The latter two factors are operational ones, not directly related to the topic of this paper. The first two however, are key to our proposal. In fact it is difficult to envision that employees can be "trained as frequently as possible" without strong and specific support of the administration. Therefore, the process of moving from a sporadic, unrelated set of activities to a planned or systematic program with clear objectives geared to individual and institutional requirements must be approached not only in a stepwise fashion, but also in a controlled and top-down manner.

The following is an outline of how a library system with limited resources might approach the problem - given administrative commitment. What is depicted is a developmental plan based on the roles of key individuals and groups in the staff development process. The outline also provides some general guidelines (mostly from an administrative perspective) for the planning process. It assumes that each individual or group will use a basic systems analysis approach to planning with respect to defining needs and objectives, examining constraints, and selecting, implementing, evaluating and modifying methods/activities. The strategic roles for those involved in the developmental plan (e.g. library administration, training and development specialist, advisory group) are recommended to be as follows:

Administration: articulate short-term and long range goals; provide an organizational view of staff development needs; appoint a person at a senior level to take primary responsibility for planning, implementing, monitoring, and evaluating the staff development program. A goal of the program might be, for example to develop a staff capable of initiating and accepting rapid change. A specific organizational objective related to this goal could be the development of staff at the professional and paraprofessional level with the following skills/competencies: computer literacy; report and proposal writing; analysis or problem solving (i.e. defining problems, data collection, data analysis); cost/benefit analysis and systems analysis. Any well designed program should include the use of external sources, within and outside the organization - viz. library school, neighboring institutions with strong programs, local higher education councils, and other local, regional and national organizations to which the library system belongs.

Training and development specialist: develop a long-range plan, within two years at most, that is sensitive to organizational requirements and constraints; develop a PERT, CPM or planning chart to establish time-frame and bench-mark events for developing a systematic program; develop program evaluation criteria; work on the establishment of a system-wide advisory committee; include all supervisory staff in the planning, organizing and implementation of the program in order for it to become an integral part of each unit's operations - i.e. not an add-on activity; develop program policy; delineate existing library system and institutional resources available to support the program (e.g. release time, travel support, funded research programs, in-house publications, tuition refunds, formal course offerings, workshop/seminar registration support, etc.); and prepare proposals for external funding of innovative programs.

Advisory/Steering Committee: a unit-wide committee with representatives from the staff and management, with responsibility for advising the Development Specialist on time frame, acceptance of the program plan, policy guidelines, resource materials and specific training and development needs and activities.

Staff: participate in the program; contribute to the needs analyses; discuss institutional goals, requirements and constraints with Advisory Committee members, in relation to personal development needs; assist in preparation of training and development materials; and make recommendations for program improvement.

Institution: provide resource personnel from other offices such as Human Resources, Affirmative Action, Computer and Information Systems, faculties from professional schools, other counseling personnel and the Development Office.

The many techniques that a library can use within a staff development program are readily found in articles or books such as those by Weber (13), Creth (14) and Rutledge (15). They explain the utility of activities such as job exchanges, job sharing, and in-house seminars or workshops. Some less common techniques for an "in-house" program such as assignments to committees, the establishment of a "buddy" system with library and information science faculty, and use of the new technology itself - all point to the need for the planners of a training and development program to be creative and innovative in their thinking.

Conclusion

Most library systems are currently living through turbulent technological times with dynamic effect on the rate and nature of change in operations. Due to the process of technological change in knowledge-based applications, it is possible to predict the nature of future technological innovations in libraries and to prepare staff and operations accordingly. We thus see the need for active staff development programs for existing staff and revised minimum requirements for new hires. These are directly related to the present and future requirements of library organizations and their involvement in the development of the next paradigm for rapid and comprehensive access to information.

Most libraries have had experience with only minimal levels of staff training and development activities to date. Future changes in these organizations, largely due to the press of new technology, will demand that the top administrative levels in library systems must show commitment and provide the support needed to make frequent training possible. While some of an institution's resources must be allocated to ensuring that an innovation functions effectively and becomes a routinized part of operations, unless frequent training is ensured, it is highly likely that the innovation will fail to make an impact. Therefore a more systematic and controlled approach is recommended.

This paper has specified roles for key individuals in a library organization that would set them in motion to articulate a developmental plan for staff development and training. The delineation of these roles assumes that a standard systems analysis approach will be used in specifying needs, constraints, and options and in implementation. While this approach may not lend itself to all environments, it may serve as a guide post in libraries which, to date, have had only limited or uncoordinated staff development and training activities.

REFERENCES

1. Keller, George, Academic Strategy: the Management Revolution in American Higher Education (Baltimore: Johns Hopkins University Press, 1983) p. 19.

2. Naisbitt, J., Megatrends. New York: Warner, 1984.

3. Tecker, G., "The Role of the Professional Association," Leadership Enhancement Program, American Library Association, Midwinter Meeting, January 4, 1984, Washington, D.C., p. 3.

4. Sahal, Devendra, Patterns of Technological Innovation. Boston: Addison Wesley, 1984.

5. Drucker, Peter, Innovation and Enterpreneurship: Practice and Principles. New York: Harper & Row, 1984.

6. Moran, B.B., Academic Libraries: The Changing Knowledge Centers of Colleges and Universities. Washington, D.C.: Association for the Study of Higher Education, 1984. (ASHE-ERIC Higher Education Research Report no. 8)

7. Elliott, L., "Professional Staff Development in Academic Libraries," Journal of Librarianship, Vol 15, no.4, 1983, p.237-253.

8. Kaser, David, "The Training Subsystem," Library Trends, Vol. 29, no.1, 1971, p. 71-77.

9. Office of Management Studies. Professional Development in ARL Libraries. Washington, D.C.: Association of Research Libraries, 1986. (Systems and Procedures Exchange Center (SPEC) Kit 86)

10. Mason, R.M., "Micros, White Collar Workers and the Library," Library Journal, Vol. 109, 1984, p. 2132-2133.

11. Rutledge, D. B., "Job Permanency: the Academic Librarian's Dilemma is the Administrator's Challenge for the 1980's," Journal of Academic Librarianship, Vol. 7, 1981, p.29.

12. Yin, Robert K. "Life Histories of Innovations: How New Practices Become Routinized." Public Administration Review, January/February, 1981, pp. 21-28.

13. Weber, D.C., "The Dynamics of the Library Environment for Professional Staff Growth," College & Research Libraries, Vol.35, no.4, 1974, p. 259-267.

14. Creth, Sheila, "Staff Development and Continuing Education," p. 189-225. In Creth, S. & Duda, F. (Eds.), Personnel Administration in Libraries. New York: Neal Schuman, 1981.

15. Rutledge, D.B., Ibid.

Track IV

Telecommunications/Networking

Telecommunications/networking technology is the foundation for integration on our campuses, including such subjects as innovative hardware and software strategies for local multivendor area networks, intra- and inter-state computing networks, and voice/data communications.

Coordinator:
John W. Eoff
New Mexico State University

Lynda Barner
Carnegie Mellon University

Stephen Kelley
CSU/Long Beach

David Phillips
Pennsylvania State University

Planning Model for Computing and Telecommunications

Frank Slaton

California State University
San Bernardino
California

If you are developing separate plans for computing and communications networks you may not be responsive to the expanding need for access to today's information resources. This paper describes a simple micro-based spreadsheet model that can help you (1) Identify the types and quantities of computer and telecommunications resources involved, (2) Better understand the relationships between these resources, (3) Identify changing requirements, (4) Budget for multi-year growth of your telecommunications network and (5) Assure a secure and responsive network.

We are being challenged to explore the impact of converging information technologies. Our relative comfort with computing technology may keep us from harnessing the full telecommunications power our University needs. According to Clemons and McFarlan "To make full use of the opportunities that telecommunications presents, managers will need some help from experts. Bridging the gap between specialists in telecommunications technology and general management for purposes of strategic planning is, however, an enduring problem. Since general managers are often uncomfortable with technology, many are unaware of new options the technology provides and the ways in which telecommunications can support strategy." [1]

The model described in this paper was designed to provide a comfortable, yet meaningful, bridge between you and the sometimes confusing world of telecommunications.

Some twenty years ago your campus terminal network may have looked like the diagram in Figure 1. A few terminals were connected to a host computer - probably located miles away from your own campus. To link the ultimate proliferation of work stations to a wide variety of host computers, the data communications technology has brought us the terminology shown in Figure 2. To show how this family of data communications equipment might be used on your campus, a simple spreadsheet model has been developed. The model can be implemented on any of the many popular spreadsheets available for your micro computer. In Figure 3 you will note that the main segments of the spreadsheet relate to the three columns on Figure 2. The brand and model of host computers are entered under Column A, etc. The spreadsheet data can be printed without grid lines and column headings, and lines drawn in to show the linkages (Figure 4).

Now that you have the model built, let's look at ways it can be used to capitalize on the "converging technologies". Figure 5 lists 21 possible uses of the model, arranged under the following categories: (1) Exploring critical issues, (2) Evaluating alternatives, (3) Incorporating new technology, (4) Developing service level agreements, and (5) Anticipating the future.

Exploring critical issues. You may have already identified issues that are critical to telecommunications at your University. As an example, the issues may involve: maintaining on-line services, authorizing access, accomodating growth, and controlling costs. Let's look at how the model can aid in these important areas.

Maintaining on-line services. With your University staff becoming more and more dependent on on-line access, there are certain types of information processing you may deem particularly critical (e.g., student registration, financial inquiries, student labs). To minimize disruption to such processes the model can highlight alternate routes that are available in the event of network failure or scheduled interuption for maintenance or upgrading. Portions of the model Figure 3 (Rows 18, 20 and 25; Column L) shows the "TAB" model of workstation being used as both an asychronous terminal and as a bi-synchronous terminal (by being attached to a "Renex ctlr" (a protocol convertor). The use of standard equipment may allow the relocation of workstations during repairs. If you are maintaining your own cable plant, your vulnerability to interruption of service may be detected in the model. This is particularly important if you are in a thunderstorm area or are undergoing construction.

Authorizing access. Access to central computing facilities from the work stations is authorized by one or more of the following controls: (1) Password, (2) Account number (3) Hardware "lock outs" or (4) Some combination of the first three. The model can help identify the controls in place, and assist in security reviews. The switch labelled "MICOM" in Figure 3 (Row 27, Column E) is an example of combining software/hardware control. The work stations connected to the MICOM switch may be restricted to certain processors by software controlled at the console of the switch. This control of course is only as good as the security of the console location.

Accommodating growth. To accomodate growth, the model can show the communications hardware's expansion capability. Modularity may allow additional cabinets to be added, given that you have the floor space and can stand any degraded response time that might result. The model in Figure 3 (Rows 12, 27; Columns B - D) shows that the processor on the CYBER series CPU's can be expanded by adding additional ports. Although the asynchronous and bi-synchronous ports are show as being in separate processors, they are actually in a single cabinet, and the asynchronous/bi-synchronous mix can be changed by simply changing boards.

Controlling costs. The first step in controlling costs is knowing the components of costs which the model can identify. Costs may be compared for alternate workstation/network configurations. Once this is known, plans and budgets can be developed. The model can help you develop the project implementation plan. Segmenting contracted and in-house maintenance is aided by the model.

Evaluating alternatives. Management often has to choose between alternate funding sources. Many of these sources are providing single-year funding which favors purchasing. Contrast this with the changing technology that may favor leasing. Consider a typical equipment lease contract that has a purchase option in it. Figure 3 (Rows 6 - 12, Columns J - M) shows a typical 3270-type configuration of controllers and displays (connected printers are not shown). If you exercised the purchase option to purchase some previously leased equipment, this model may help you decide which devices you would purchase. With controller technology changing, you may opt to only purchase the displays.

The model can help you compute the costs of providing access to different categories of users - students, faculty, administrators (Figure 3, Column N). The needs and access patterns of the different categories of users may justify different contention ratios as well as different access speeds.

Incorporating new technology. The model can illustrate the opportunities provided by incorporating new technology. Software at the master station of a LAN can now allow asynchronous terminals to access host computers bi-synchronously. A bi-synchronous controller may now be augmented with a local processor to provide office automation type functions from existing work stations without tying up the host.

Developing service level agreements. The model will help in your defining and negotiating service level agreements. If your only service is providing "utility company" type access, the model can illustrate the access routes (buildings and departments served). If you are providing the "information center" type services, the model could be a visual aid during consulting and training, a control sheet during project management of installations and help you group like workstations when "negotiating" maintenance service agreements.

Anticipating the future. The model comes in handy when forecasting the impact of technological changes. Additional off-campus access, including voice mail, could be an added service of the switch function. With more and more telecommunications services handled through the switch, costs may be accounted for by users through billing software.

Conclusion. As you gain experience in developing and using your model you will undoubtedly think of ways to customize and expand it. Figure 6 suggests several ways to add value to the model--either by adding columns to the spreadsheet or linking worksheets with more detail. Once you have expanded the model you will find additional uses, such as predicting workstation response times and calculating departmental telecommunications budgets.

---

[1] "Telecom: Hook Up Or Lose Out", Eric K. Clemons and Warren McFarlan, Harvard Business Review, July-August 1986, page 91.

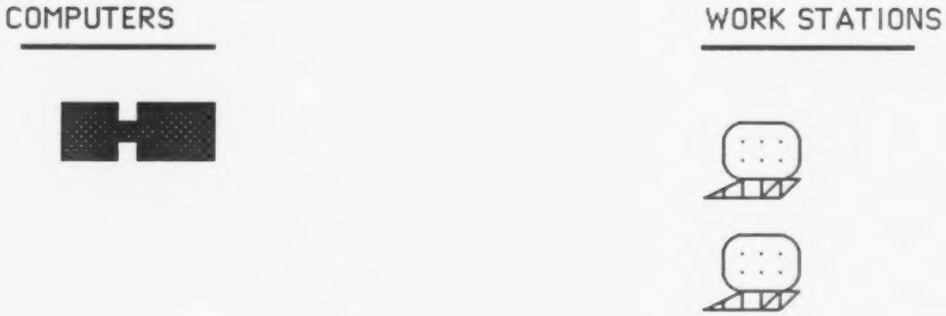

COMPUTERS
WORK STATIONS

Figure 1

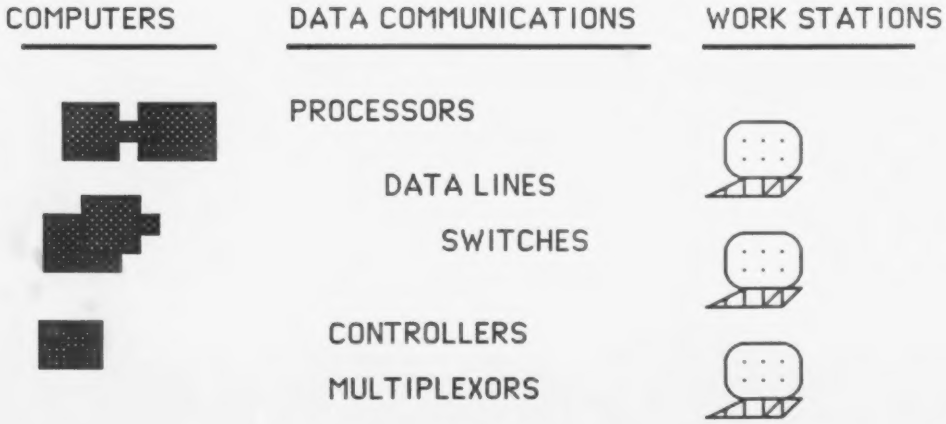

COMPUTERS
DATA COMMUNICATIONS
WORK STATIONS
PROCESSORS
DATA LINES
SWITCHES
CONTROLLERS
MULTIPLEXORS

Figure 2

DATA COMMUNICATIONS - Cal State San Bernardino

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	COMPUTER	PROCESSOR	PROCESSOR	PROCESSOR	SWITCH	SWITCH	SWITCH	SWITCH	SWITCH	CONTROLLER	CONTROLLER	WORKSTATION	WORKSTATION	PROGRAM
2		MODEL	(PORTS)	(PORTS)	MODEL	(PORTS)	(PORTS)	(LINES)	(LINES)	MODEL	CAPACITY	MODEL	QUANTITY	
3			CAPACITY	INSTALLED		CAPACITY	INSTALLED	CAPACITY	INSTALLED					
4		----------	----------	----------	----------	----------	----------	----------	----------	----------	----------			
5														
6										CTLR-ITT-1	32	ITT DISPLAY	18	Admn
7														
8														
9										CTLR-ITT-2	16	ITT DISPLAY	14	Admn
10														
11														
12		NPU-bisynch	12	6						CTLR-ITT-3	8	ITT DISPLAY	2	Admn
13														
14														
15														
16										CTLR-IBM-1	8	IBM DISPLAY	2	Admn
17														
18	CDC 830									CTLR-RNX-1	8	TAB	4	Admn
19														
20										CTLR-RNX-2	12	TAB	4	Admn
21														
22														
23														
24														
25												TAB	26	Admn
26														
27		NPU-asych	48	48	MICOM	186	112	294	134					
28														
29	CDC 720													
30														
31														
32	PDP 11/44		32	32										
33														
34														
35	PRIME 9755		128	32								TELERAY	22	Faculty
36												TAB	3	Faculty
37												FREEDOM	15	Faculty
38														
39												VARIOUS	68	Students
40														
41	TOTAL		220	118							84		178	

Figure 3

DATA COMMUNICATIONS - Cal State San Bernardino

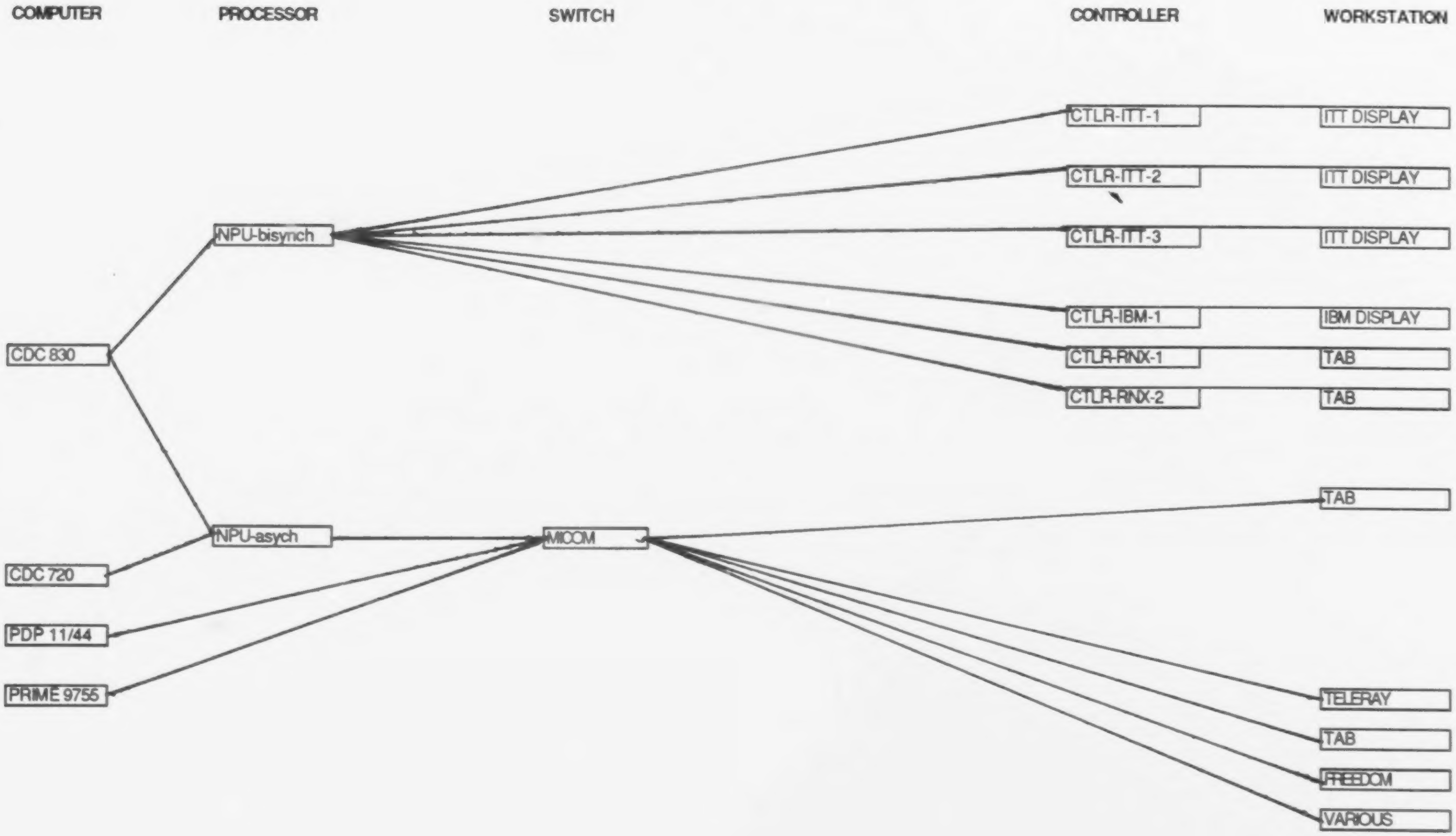

COMPUTER
PROCESSOR
SWITCH
CONTROLLER
WORKSTATION
CTLR-ITT-1
ITT DISPLAY
CTLR-ITT-2
ITT DISPLAY
NPU-bisynch
CTLR-ITT-3
ITT DISPLAY
CTLR-IBM-1
IBM DISPLAY
CDC 830
CTLR-RNX-1
TAB
CTLR-RNX-2
TAB
TAB
NPU-asych
MICOM
CDC 720
PDP 11/44
PRIME 9755
TELERAY
TAB
FREEDOM
VARIOUS

Figure 4

USING THE MODEL

EXPLORING CRITICAL ISSUES

MAINTAINING ON-LINE SERVICE
1 Alternate routes
2 Standard equipment
3 Cable Plant

AUTHORIZING ACCESS
4 Software
5 Hardware
6 Software/Hardware

ACCOMODATING GROWTH
7 Modularity
8 Capacity
9 Response Time

CONTROLLING COSTS
10 Costing alternatives
11 Developing Plans
12 Contracting maintenance

EVALUATING ALTERNATIVES

13 Funding options
14 Cost/benefit analysis

INCORPORATING NEW TECHNOLOGY

15 LAN Software
16 Local Processors

DEVELOPING SERVICE LEVEL AGREEMENTS

17 Access
- Location
- Workstations
- Software

18 Information Center
- Consultation
- Training
- Installation
- Maintenance

ANTICIPATING THE FUTURE

19 Off-campus access
20 Addition of voice input/output
21 Accounting for costs

Figure 5

EXPANDING THE MODEL

Adding columns

- Cable plant
- Costs
- Application
- Modems

Linking worksheets

- Processors
- Switches
- Controllers
- Workstations
- LANs
- Year/month

Figure 6

TEMPLE UNIVERSITY COMMUNICATIONS PROJECT
A CASE STUDY

Barbara L. Brownstein, Ph. D.,
Provost

and

Michael J. Hathaway
Associate Vice President,
Computing and Information Services

Temple University
Philadelphia, PA

Many colleges and universities are evaluating their communications needs and planning to implement campus wide or multi-campus voice and data communications systems. Temple University has completed the installation of its comprehensive multi-campus communications system -- OWLNET. The project includes:

- a multi-campus 10,000 station voice system,
- data access to all computing resources at 19.2 KBS,
- host-to-host communication between major University computing centers, and
- catalog search in the University's main library.

Projects proposed for completion in January 1987 include University wide electronic mail, bulletin board, and video text services, as well as full circulation and reservation access to the University's six major libraries from all campuses.

Temple's experiences in defining its needs, developing a strategic communications plan and implementing that plan present a case study in integrating cost-effective communications with required services in a complex, multiple campus, major research university.

TEMPLE UNIVERSITY COMMUNICATIONS PROJECT
A CASE STUDY

INTRODUCTION TO TEMPLE UNIVERSITY

Temple University is a large urban research university composed of 31,000 students, over 2,500 faculty, and approximately 120,000 alumni. It has an annual budget of $480 million. The University is over 100 years old and maintains a strong teaching and research mission dedicated to making affordable education of excellent quality available to students of richly diverse backgrounds. This mission predates Temple's becoming a member of the Pennsylvania Commonwealth System of Higher Education in 1965 and has been considerably strengthened through that relationship. The University is comprised of fourteen schools and colleges:

- College of Allied Health Professions
- College of Arts and Sciences
- School of Business and Management
- School of Communications and Theater
- School of Dentistry
- College of Education
- College of Engineering, Computer Science and Architecture
- College of Health, Physical Education, Recreation and Dance
- School of Law
- School of Medicine
- Esther Boyer College of Music
- School of Pharmacy
- School of Social Administration
- Tyler School of Art

Temple University's Paley Library is a major research library with distributed holdings in every school and on every campus. Temple's Libraries are members of the Center for Research Libraries (CRL), the Association of Research Libraries (ARL) and the Research Libraries Group (RLG) with access to the Research Libraries Information Network (RLIN) and the On-line Catalog Library Center (OCLC).

The schools and colleges offer over 100 baccalaureate and a similar number of master level degree programs, and 78 doctoral programs. They also offer certificate opportunities and hundreds of continuing education courses. Temple owns and operates two international campuses, one in Italy and one in Japan. It also has ongoing major collaborative programs with institutions in England, Ireland, the Netherlands, Germany, Nigeria, and the People's Republic of China.

The University has five campuses in the Philadelphia area:

Main Campus: 17 blocks north of Philadelphia's City Hall, this campus covers 85 acres in the heart of North Philadelphia and serves as the center for all but the Health Science Schools and the Tyler School of Art.

Health Sciences Center (HSC): located on a 16 acre tract one mile North of the Main Campus, this campus houses the new 500 bed Temple University Hospital, the four Health Science Schools and Colleges, and most treatment facilities and consultation offices of the University's Clinical Faculty Practice Plan (CFPP).

Ambler Campus: located in a suburb of the city on 187 acres, this campus accommodates the Universities space intensive landscape design and horticultural programs. Ambler also provides a campus of convenience to students who work in the large office, manufacturing, and research corridors to the North and West of Philadelphia and offers undergraduate and graduate courses to a student body of approximately 5,000.

Temple University Center City (TUCC): located in two center city Philadelphia office buildings, this campus serves as a focal point for continuing education and offers courses in 70 departments of 13 schools to a student body of 3,000.

Tyler Campus: located on 14 acres just North of Philadelphia, this campus houses the Tyler School of Art.

Temple also maintains two conference and retreat facilities in the Chestnut Hill section of the city about 10 miles from Main Campus: the Albert M. Greenfield Conference Center at Sugarloaf and the Eleanor Widener Dixon House.

TELECOMMUNICATIONS PROJECT BACKGROUND

By 1983, Temple had embarked on a number of major new initiatives. Temple's Hospital and Practice Plan staff were in the process of planning for the construction of a new 500 bed facility and the complete renovation of the old hospital for use as Clinical Faculty Practice Plan treatment and office space. The first phase of the library computerization project was underway. Through the leadership of the University President's Chief of Staff, Robert G. Scanlon, a long range strategic Plan for Computing and Information Systems (the Scanlon Plan) was begun. Finally, and most importantly, Temple's Provost embarked on a massive effort to completely re-examine the University's mission, goals, structure and resources -- in short the development of the Temple University Academic Plan for the ten year period ending in 1995. At the same time, Temple was attempting to cope with and plan for far more mundane matters such as the divestiture of the AT&T system. One the projects which immediately fell out from these processes was the Temple University Telecommunications Project. The immediate needs of the Hospital and Practice Plan coupled with the long range needs identified in the Scanlon Plan and the strategic directions defined in the Academic Plan all demanded a state-of-the-art telecommunications system which would allow the University to control its destiny in terms of costs and its ability to add services and to support the future mission of the institution.

PROJECT GOALS

The combination of immediate and long term needs directly translated into three primary project goals:

- To install new telephone and telecommunication service in Temple University Hospital in conjunction with the opening of the new Hospital facility.
- To provide improved telephone service at a lower price to the University community.
- To provide every faculty member, student and relevant administrative and staff position with a means to access appropriate computing resources and capabilities. Ultimately, this access is to include the library circulation system and remote data bases through such facilities as the Research Libraries Information Network (RLIN) and other off campus networks and data bases.

The process by which these goals were selected recognized that, with the divestiture of AT&T and the impending competition of Bell operating companies in a growing market, the types of telecommunication services available were in a state of tremendous change and that consensus standards were not likely to be completely defined for years. It also recognized that vendors of telecommunications systems provide products based on different assumptions about system architecture, cabling media and network configuration.

With these issues in mind, the first task was to conduct a comprehensive inventory of the University's current telecommunication system environment. This task was divided into three major components: voice, data, and video.

DEFINING NEEDS

Assembling the basic voice communication equipment inventory was a relatively straight forward process. Temple was a Centrex user, all equipment was owned by Bell and was billed to the University on a piece by piece basis. At the time of the development of the RFP, the equipment list included:

- over 6000 lines,
- over 3000 six button hand sets,
- over 3000 buzzers,
- hundreds of ten and twenty button hand sets, and
- over 100 call directors.

There were also almost 100 foreign exchange lines in heavily called areas. In addition to the existing service, the University also wished to extend voice service to its 3000 dormitory students. Prior to this initiative, dormitory telephone service was independently contracted between students and Bell.

The inventory of data equipment and existing service, though requiring more in-house effort to research, was made easier by the fact that there were a limited number of data circuits. The primary difficulty was that there were various sources for data communication services including Bell owned intra- and inter-campus lines, in-house intra-campus wiring, low speed dial up, and high speed DDS circuits. Basic data service at that time was divided into three classes:

- the administrative network (ADNET) which provided 3270 type terminal service to the University's administrative offices,

- the central academic network (EDNET) which served the needs of users of the central data center by connecting ascii terminals and remote job entry sites via modems, and

- miscellaneous networks, some Bell owned and some in-house, which were strung point-to-point throughout the institution and usually used to connect various devices to a departmental computer.

Of the three classes, the last was by far the largest. Host-to-host communication was limited and tended to occur at a departmental level when it occurred at all (e. g., connection of two PDP or VAX types of Central Processing Unit's)

Two video applications were also running at Temple, a medical education channel which was used as part of a network established by medical schools in the city, and an electronic bulletin board displaying a calendar of upcoming events and other information of general interest.

In this environment, the definition of needs had to be cognizant of the following factors:

- all existing services had to be maintained when the new system was installed,

- plans for future services ranged from the well defined to statements of direction to bare speculation,

- projected growth of service ranged from constrained (as in the voice area, where projected student enrollment and, therefore, staff size was to increase minimally, if at all) to exponential (the Scanlon Plan outlined an environment of almost universal data service to virtually all academic and administrative staff and where investments in academic computing would provide students with orders of magnitude more capabilities), and

- Technology in the data communication area was changing rapidly and, when the installation phase of the project was completed, the University wished to be in a position to be able to take advantage of appropriate technological advances which were at present undefined.

DEVELOPING THE REQUEST FOR PROPOSALS

The Request for Proposals, developed largely by Temple's Director of Telecommunications, John K. Patterson, and the Director of Telephone Services, Claire McNicholas, addressed the issue of different competing vendor approaches to providing integrated voice, data, and video communication in a changing environment by specifying functional requirements rather than specifying a preferred approach to the problem. This method had a number of advantages. First, it allowed each vendor to creatively present the particular strengths of their technical strategy within the Temple environment. Second, the task of matching system features to University requirements fell on the vendors and not on the limited University staff. The vendors, after all, had access to the engineers who designed the system and could best assess its strengths and, at least by omission, its weaknesses. Finally, the functional approach taken in the RFP allowed the University to demand and receive, as soon as they became available and as part of the initial contract, products which were not yet developed when the contract was signed. The performance objectives included all anticipated needs including:

- conversion and ten year projections of voice and data configurations in aggregate and by building on each campus,

- minimally acceptable transmission speeds, bandwidth, and switch features,

- required and optional system, management, and station features of the voice component,

- cabling requirements, not in terms of specifying the cabling plan, but by demanding that all cable would be new and that both inside and outside plant wiring was the responsibility of the vendor,
- acceptance periods and documentation standards,
- initial training and transition assistance, as well as development of materials which could be used to train future users of the systems,
- post installation service support requirements, and
- financing requirements.

Given that vendors were going to propose various approaches to meeting Temple's communications needs, it was critical for purposes of evaluation to impose on them a strict standard proposal format so that cross vendor comparisons could be made with a minimum of effort. This had to be accomplished without impinging on the requirement for each vendor to present their system features in the best light. To meet these objectives, the proposal format specified required chapter contents and optional areas for each proposal topic.

PROJECT PLANNING

Specific goals, objectives, system design and architecture for the Temple Communications project were laid down during the contract negotiation process. The contract incorporated the vendor proposal and more clearly defined responsibilities between the two entities. This process took several months and was undertaken with the two finalists in the selection process. Only after a complete understanding of each technical proposal was gained, did the selection committee present the alternatives to Temple's President and Executive Cabinet. Ten year detailed cost projections indicated that substantial savings would accrue over the course of the expected life of the system with most of those coming in the last years. The financial projection included only savings from voice communications; the opportunities afforded by the installation of new wiring plant and capacity had, as far as the financial projections were concerned, a marginal cost of zero. Thus, the system was cost justified on voice alone.

Temple chose Bell Atlantic to be its telecommunications project provider. The project that was ultimately defined as Bell's responsibility included installation of two PBX switches, one at Health Science Campus and one at Main Campus, installation of wiring conduit where required, installation of fiber optic cable and twisted pair wiring throughout the various campuses, installation of all voice instruments, cross connecting all wiring to appropriate levels at floor closets, building or main distribution frames and switches, wiring and station data base development and control, and day-to-day project management. After a review of the cost to provide data communications through the PBX, the project team chose to acquire a separate data switch from another vendor and to use the wiring that was part of the project for basic terminal service.

PROJECT ORGANIZATION

Once the selection process was complete, Bell and the University assembled a joint project team. The University staff supplied to the team included:

- a full time project director, who was to be the Director of Telecommunications when the installation phase was completed,
- a plant and wiring consultant, to review the wiring and cross connect work as it was completed (who, as it happened, was the retired field engineer formerly assigned to the University by Bell and who was very familiar with Temple's environment),
- staff from the existing Telephone Services, including the director of that organization, to assist in the development of station plans for all offices in the University and to review the wiring and station data base as it was developed, and
- a liaison person within physical plant.

This last was required because though all wiring was the responsibility of Bell, the particular technical solution chosen required that a number of switch rooms be built on all campuses. Each room was essentially a computer room with an Uninterruptable Power Supply (UPS), emergency generator and redundant air conditioning capacity sufficient to cool all installed and planned switching equipment. It also allowed Physical Plant to piggy-back conduit work which it needed with the work being done by Bell.

From the University's perspective, it was absolutely critical that its project director be able to devote full time to this implementation effort. As this extremely complex project developed, critical decisions had to be made or escalated to the appropriate decision maker in a timely manner. Required decisions ranged from revising the project to substitute T1 carrier for originally proposed microwave transceivers to changes in the entry point of conduit to a particular building. These decisions could only be made by a senior University representative who could get the required attention from others within the institution. In fact, in hindsight, it would have been useful to have had more representation from Physical Plant to keep the two phases of construction more in synchronization than they were.

CONVERSION

Conversion (cutover) to the new system occurred in phases as specified in the contract, with the Health Science Center being the first campus to make the conversion. This conversion was timed to coincide with the completion of the new hospital. The coordination between these two major projects was difficult. Delays in the construction and move schedules for Hospital departments were hard to predict and had clear impacts on the ability to deliver each telecommunications phase as originally scheduled. Other portions of the project were adjusted to minimize the impact of these and other delays but the final cutover ultimately occurred about ten weeks later than scheduled at the beginning of the two year project. Put another way, this is a ten percent schedule variance -- within what one could expect on a project as large as this with the constraint that Hospital service was absolutely required to be coterminous with the opening of the new facility.

Before each campus converted, a massive training effort was undertaken. The new system allowed more features and provided even familiar features in a slightly different manner than the Centrex system it was to replace. The attendance goal of the training effort was to reach every telephone user on every campus. Training efforts also included publication of a detailed telephone users manual. Training sessions were held at central locations on every campus and used a mix of video presentation and live instruction. Class size was limited to twenty. Attendance at the training sessions averaged about one-half of the scheduled participants and there was a high negative correlation between post cutover problems reported by departments and the attendance rate.

Originally, the project team had scheduled a two month period for parallel operation of the new communications system (since named OWLNET) and Centrex service. To address the pervasive lack of comfort with the new service, its features and new ways to invoke them, this period was usually extended.

The final cutover to OWLNET occurred in mid-March. This project has been a great success and achieved all of the originally stated goals. General user satisfaction levels have steadily increased with the voice system as experience and familiarity have increased. In the non-voice areas which were to be addressed by the network progress has also been dramatic.

- Data communications service is available to all dormitory residents who request it.

- All University central site computing resources are available on the data network (now named the WISEOWL network) and terminal service is provided at unblocked speeds to 19.2 KBS.

- The Paley Library computerized catalog is available to any individual connected to WISEOWL, as well as from terminals located in libraries at Main and remote campuses.
- The library is acquiring an upgraded circulation system to allow full library Boolean catalog searches and book reservation services from WISEOWL.
- The Office of Television Services has installed the first video application using the system.
- Data service is being extended to the offices of up to half of the full time faculty.
- Bridges are being established from major departmental computing networks to WISEOWL.
- A pilot project is underway to establish a network node to provide additional value added services such as formalized University wide electronic mail, bulletin board and video text.
- Off campus network nodes have been or are being added including BITNET and NSFNET.
- A very high speed host-to-host communication backbone is under evaluation to connect all appropriate CPU's for such applications as file transfer.

INTEGRATING COMMUNICATIONS WITH EXISTING AND FUTURE SERVICE

The implementation of Temple's Communications Project represents an important investment in the University's future. By installing large amounts of bandwidth over and between its campuses as part of the overall telecommunications system and by being able to cost justify that investment on the basis of savings in the voice area alone, Temple is positioned to take full advantage of future technological advances in computing, data base accessability and communications. By committing itself to and acquiring only those protocols, products and services which it can use immediately, Temple can afford to wait until consensus standards are defined within the communications industry, thereby decreasing the risk of aligning with a product which is a "non-survivor".

Temple is also in a position to serve as a partner with corporations which are willing to share in its institutional missions and assist it in delivering services to its community of students, scholars and neighbors. Partnership arrangements can take avantage of the foundation of technical capabilities in which Temple has already invested to meet both the bussiness needs of the corporation and the educational and research needs of the University.

ACKNOWLEDGEMENTS

The development and implementation of this project was largely the responsibility of the following people. We thank them for bringing the project to fruition and for their assistance in the preparation of this report.

Robert Scanlon	Vice President for Planning and Operations
John Patterson	Director of Telecommunications
Claire McNicholas	Director of Telephone Services
Susan Foster	Director of the Office of Computing and Information Systems

Can WANs and LANs Make Good CANs?

Stewart H. Robinovitz
Information Technology Division
The University of Michigan

ABSTRACT

Can Wide Area Networks (WANs) and Local Area Networks (LANs) make good Campus Area Networks (CANs)? Or more concisely, can those products purported to be LANs or WANs make good Campus nets? This is an important question because it seems computer users are clamoring for local area networks (even though they are not really sure what they are) while administrators are clamoring for campus networks (and are equally unsure what the current wave of campus nets should be).

The terms LAN, CAN or WAN, are so ill defined, or in reality posses so many different meanings, that they verge on being useless terms. We will, therefore, look at a new classification schema for networks. Once defined, we will then apply this schema to the current offerings of several major vendors, and see how they might fit into campus wide networking.

CURRENT NETWORK TYPES

There are several defacto classifications that are currently used for networks. Vendors often use only the classification that makes their network look best, and ignore the others. These classifications are usually based on a vague area of coverage, service or functionality, sometimes just the vendor name, sometimes the protocol and sometimes the media.

These categories need to be specifically stated, and when possible should reference existing standards. Then a given network product can be adequately compared to another as well as compared to the requirements and constraints for a given situation.

OSI MODEL

The International Standards Organization (OSI) has developed a model that is designed to describe networks, and serve as the framework for standards. Any classification scheme should take this model into account.

The model is as follows:

Higher Level Functions

Application Layer	Layer 7
Presentation Layer	Layer 6
Session Layer	Layer 5

Transport services

Transport Layer	Layer 4
Network Layer	Layer 3
Link Layer	Layer 2
Physical Layer	Layer 1

We will not go into details of the OSI model at this point except to note the following:

The "transport services" are those things that will get messages, data or connections from one node to another, while the "higher layer functions" address some of the real work of the network. A good deal of standards activity has gone into the transport services, and now higher layer standards are also beginning to emerge for such functions as electronic mail, file transfer and access and virtual terminal attachment.

The object of the lower layer, or transport services standards is to allow multiple vendors products to co-exist in the same physical network, to allow different lower layer networks to interconnect, and to allow an independence of higher layer functions from those below. The higher layer standards will allow interactions at a functional, application level, and further promote independence of higher layer functions from those below. The end result would be that one could pick and choose components of a network, within layers, as well as between, from various vendors. While this is the goal, we will see that certain vendors intentionally blurr the line between layers, to force customers to an all or nothing choice.

PROPOSED TAXONOMY

A meaningfull taxonomy can be developed, that can help compare and analyze various network vendor's offerings. The categories can be grouped by those that fall within the lower layer functions of the OSI model, or transport categories, and those that apply to the higher layers, or functional categorizations. The categories are:

Transport Categories

- Topology
- Physical Media
- Area of Coverage
- Link Protocol
- Speed or Bandwidth

Functional Categories

- Highest Layer Served
- Application Layer Services

Topology - The topologies commonly used for networks include the ring, star, tree, plex, and folded ring or pseudo-star.

Ring - A ring in its simplest form is merely a closed loop. The significant charcteristic of a ring is that the nodes are sequentially ordered, with the first connected to, and following the last.

Star - A star is composed of independent branches, each connected to a hub. In a true star each branch is independent.

Tree - A tree is a multiple branching configuration that can be either directional or not. In its simplest form it is a single trunk, with drops.

Plex - A plex is a multiple connected web like structure with multiple paths between many nodes.

Pseudo-star or folded ring - Pseudo stars or folded rings look like stars but act like rings or trees.

Physical Media - The most common physical media includes baseband coaxial cable, broadband coaxial cable, baseband twisted pair cable, along with minor use of infra red, microwave, and low power radio.

Baseband coaxial cable - Baseband coaxial cable is used mostly for

Ethernets, with some use in proprietary token networks. These work for room, building, and building clusters, but complete distribution is not usually practical. These have been the most popular for high speed, full function networks, but twisted pair is beginning to surpass it for full distribution.

Broadband coaxial cable - Broadband coaxial cable technology is used for building through campus sized networks for medium to high speed networks. This technology was dominant, but it was soon found that the cost of design, installation and maintenance was much higher than originally anticipated, and grew even higher in proportion when full building distribution was attempted. Thus broadband is starting to be used solely for trunks.

Baseband twisted pair - Baseband twisted pair (which is ordinary twisted pair) is currently used for telephone systems, campus, metro and even wide area networks. Twisted pair wire is being used commonly for 19,200 Bps. asynchronous, and 56 Kbps synchronous for transport networks at campus distances and in some cases metro net distances. It is also being used for 2.5 Mbps. for building cluster networks and up to 6 Mbps. for floor distribution networks. There is also a specialized shielded twisted pair that IBM recommends for floor distribution, but it has not gained much acceptance.

Fiber optics - Fiber optics is beginning to be used in networks. Wide area networks are increasingly carried on long haul high capacity single mode fiber optics. Metro networks are experimentally using fiber, and fiber is being used to link building and building clustered concentrators. Fiber's biggest drawback is its lack of standardization. There are several different proposed standards, all incompatible, and so at present it is prudent to limit its installation in massive quantities.

Area of Coverage - Area of coverage is a useful categorization. Many networks fell into specific area coverage based on technological considerations, due to the transmission techniques and media. However, some vendors then tried to turn this around and claim that the networks were designed this way on purpose because that is how organizations map to building geography.

The area of coverage categories are:

Room coverage - Networks that are primarily for room coverage generally extend for distances in the 50 to 100 foot distance. They are generally full function, low cost, medium speed, personal computer networks using twisted pair or "thin" or "cheap" baseband coax or occasionally fiber optics. They tend to be somewhat inflexible limited capacity networks best for open lab or classroom use.

Floor distributed networks - Distances of up to 400 to 500 feet. These tend to be high speed and use twisted pair, baseband or broadband coaxial cable. The limits are generally imposed by the transmission techniques used, so that noise and signal distortion often precludes large networks in terms of total distance and number of nodes. The initial AT&T Starlan fell within this as does the IBM Token Ring on standard wire.

Building - Distances of 400 to 900 feet, similar to floor networks, but with more robust transmission methods. AT&T Starlan now falls within this, as does the IBM Token ring (but only if one uses the specialized IBM shielded twisted pair wire). Some baseband Ethernets are also used for this coverage but complete coverage is expensive, and difficult to maintain, due to the vast number of nodal drops, for complete building coverage.

Cluster of buildings - Distances of 2,000 to 3,000 feet. These were initially covered by baseband, coaxial cable, specialized star architecture networks such as the Wang Office Information System and the IBM 3270. Northern Telecom and David Systems are now offering 2 to 2.5 Mbps. general networks, with 2,000 foot distances on unshielded twisted pair, that offer great promise for complete coverage within buildings, at high speed and low cost. Broadband coaxial networks were once touted as the ideal solution for this coverage, but their high cost of installation, design and maintenance, especially for full distribution, has caused them to be offered more and more as trunk only networks, with an increasing use of twisted pair for building distribution.

Campus - Distances of 1 to 5 miles. Broadband and fiber optic networks predominate here, with a mixture of offerings of transport only networks to full function networks. Also offered are connection oriented data switch networks, as well as low power, microwave networks.

Metropolitan - Distances of 10 to 25 miles. This is the part of the network world that the local telephone operating companies are dominating, since the local cable TV franchisers have failed to organize any sustained services. Telephone local loops, data over voice and an increasing use of fiber are the main media. Speeds are within the low to medium speed range, for copper, with high speed possible for fiber. Some feel that cellular telephone services may also become important for metro nets but others feel that bandwidth and speed constraints will limit its use to specialized, low speed, connection oriented networks.

Wide Area - These networks are for inter-city, inter-state and international, and include twisted pair, microwave, satellite and fiber optics. Speeds have been creeping up from 9,600 bits per second through 56,000 bits per second, and now extended 1.5 million bit per second "T1" networks. These have tended to be connection oriented, but effective higher layer bridges can function at these speeds.

Link Protocol - There are several link protocols that are "official" standards or vendor standards. These are:

Ethernet - This is a contention protocol standardized by IEE standard 802.3 and has a one Mbps. twisted pair form, along with baseband, and single and dual broadband forms for 10 Mbps. There also is a variation called XNS, supported by XEROX, that is slowly loosing popularity.

Token bus - This was proposed by General Motors and the MAP group for factory automation, and is a broadband single cable standard, heavily used in factory automation. It is standardized by IEE 802.4.

Token Ring - This was proposed by IBM and is now standardized by IEE 802.5. It is a shielded twisted pair and limited unshielded twisted pair standard.

X.25 - This is a medium speed international wide area transport standard.

SNA/SDLC - This is a proprietary IBM transport for its mainframe based networks.

ISDN - This is a proposed standard for medium speed digital data transmission on local telephone loops.

Speed or Bandwidth - This can be divided into four general categories:

Low Speed - Anything below 19,200 Bps.

Medium Speed - Anything from 19,200 Bps. to under 1 Mbps.

High Speed - Anything from 1 Mbps. to 12 Mbps.

Very High Speed - Anything greater than 12 Mbps.

Highest Layer Served - This categorization is one that is based on comparing the services that a network provides to the OSI reference model, and determining the highest layer that the given network offers service. For example many networks merely offer connection or virtual connection services, and thus would be transport layer networks. Some of the current IBM PC networks offer full application services, and thus would be application level or full function network.

Functional Categories - Some networks offer specialized higher layer functions and are classified accordingly. Significant among these are the electronic mail networks.

MAJOR VENDOR OFFERINGS - PHYSICAL NETWORKS

The major players in the network world have all announced building or premesses wiring schemes, and a network architecture to utilize their respective schemes. These are all forms of twisted pair wire and the consensus seems to be forming that the next wave of networks, especially those for university or industrial campuses, will follow one of these. The current crop of limited baseband Ethernets, and somewhat larger broadband networks will still be used, the former for small localized networks, the latter as internet trunks. The major networks that will be reviewed are the IBM Token ring, the AT&T Starlan and the Northern Telecom Lanstar.

IBM - IBM's token ring requires IBM type 1 or type 2 shielded twisted pair wire to function maximally. These cables are considerably thicker and more difficult to work with than standard telephone wire. They take an excessive amount of cable tray or conduit space as well as huge floor "closets". Thus IBM wiring is not practical for existing buildings nor multi building campuses. IBM has announced their token ring for unshielded twisted pair; but when one looks at this one finds that there are severe distance and size (maximum nodes=72) restrictions on the use. It should be noted that the reason IBM limits its networks is that although they look like star wiring, they really are folded rings with 2 pairs of wire per workstation, so that signals must travel up and back from a hub through every single workstation, thereby encountering noise and delay problems, which get accentuated on unshielded twisted pair. Further more all floors that are interconnected actually create an even bigger folded ring. It is also the case that all the workstations share a common 4 megabit per second pipe. Thus the IBM scheme is more fit for new single building locations, or at most, a very limited amount of use of the IBM token ring network in very small buildings or on a few scattered floors where needed.

AT&T - AT&T's Starlan network is a 1 Mbps. twisted pair. It allows a maximum distance of 800 feet from a network adapter to a workstation to a Starlan hub. Like the IBM Token Ring, it is really a folded design rather than true star, using two pairs of wire for each workstation, except it is an Ethernet buss rather that Token Ring. In addition individual nodes, located in the same room, for instance, can be "daisy chained" together, to save on wire back to the hub. Due to the 1 Mbps. bandwidth, a typical Starlan's hub will be limited to 10 or 12 nodes. Hubs can be joined together, but this would merely further load up the network. These 1 Mbps. Starlan hubs may be bridged by ISNs which have a 7 Mbps. bandwidth. These ISNs can have fiber concentrators for picking up Starlan hubs. The ISN further provides both inbound and outbound asynchronous connections to attached Starlans. Finally the ISNs can also act as bridges for 10 Mbps. Ethernets, but these 10 Mbps. Ethernets cannot talk to the 1 Mbps. Starlan Ethernets.

Northern Telecom - Northern Telecom offers two products that use twisted pair wire systems. Both use two pairs of unshielded wire that provide a dedicated 2.5 Mbps. link at distances of up to 2,000 feet. One product is the Lanstar Packet Transport Equipment (PTE). The PTE connects the 2.5 Mbps. data links to a hub with a 40 Mbps. buss that is used for voice and data. Each hub can support over 1,000 data lines, although this number would most likely be smaller due to performance considerations. Northern has indicated that these PTE hubs will be linked but has only announced T1 1.5 Mbps. and PBX linkage. They are an active participant in the current efforts to develop a 100 Mbps. fiber network standard (FDDI2) so one may surmise they are considering large fiber rings to perform this linkage. The PTE is currently marketed with a Lanstar PTE PC LAN. This supports a MSNET network, licensed from Microsoft, but given Northern's "Open World" direction, and the fact that they have offered the Lanstar Link for standardization, it would be reasonable to see other networks, such as those from Novell, Banyan and 3 COM will be available on the PTE.

The other product from Northern Telecom is called the DV/1. The DV/1 uses the same 2,000 foot 2.5 Mbps. data link of the Lanstar PTE, but connects many fewer lines. The smaller DV/1 System is packaged as a combined data and voice system, offering a mix of network-like and minicomputer-like functions, including one for IBM and compatible PCs that uses the DV/1 as a server, and can also perform messaging and other functions with the DV/1's own software.

The Lanstar PTE would appear to be a good choice for campus networks, provided that high speed links are developed, and that it is supported by the leading network vendors, interfaces for standard Ethernet devices are developed.

HIGHER LAYER NETWORKS

Higher layer networks today fall into several distinct worlds. These are

The IBM compatible MS network family
The TCP/IP UNIX family
The specialized proprietary networks
The OSI networks

The first three represent real working networks, while the last, the OSI networks, is a future goal. As will be seen in the following section, what is really needed is one integrated network. Instead, what one must settle for today, are several separate networks from each of these families, and try then to develop adequate gateways.

Required higher layer functions - When surveyed, users report they want the following in a full function workstation based network:

1. File sharing- The ability of network users to access and share each others files and documents. This must be done on a controlled, secure manner.

2. Printer sharing- The ability to access and share various draft and letter quality printers. These printers need to be scattered geographically.

3. Shared application software- Users would like the ability to share a common library of select software.

4. Message systems- There is a need for comprehensive, easy to use message systems, that are fully integrated with various other message systems. This can be interpreted to mean that there must be good local message systems that are able to interface to using the SMTP or X.400 standards.

5. Communications gateways- There needs to be gateways to other networks, especially those supporting the X.25 with X.29 pad or TCP/IP with Telnet standards as well as IBM SNA and 3270.

6. Apple Macintosh integration - Apple Macintoshes should be fully integrated both at the file and message transfer

function as well as at the full application layer, for select applications.

The IBM compatible MS network family - The largest family of higher layer networks, from a commercial perspective, is that centered around IBM PCs and compatables. IBM contracted with Microsoft, Inc., to develop their networking, which is for systems using the MS DOS and PC DOS operating systems, and is commonly called MS networks. The IBM PC Network and Token Ring are based on this, as is MSNET which can be licensed by vendors to develop compatible networks.

MS networks define servers and workstations. Servers within basic MSNET include print and file, while IBM and other leading compatible vendors such as 3-COM, BANYAN and Novell add other server functions including communications, gateways, message systems and enhanced security. There is nothing within the MS network design to preclude a single machine from being both a server and workstation at the same time, but constraints of memory and cpu, at least up to and including 80286 based AT class machines, as well as lack of multiple processing in MS DOS at present, preclude a given machine from being a server and workstation concurrently. This should change with the 80386 class of machines, and MS DOS 4 and 5, however.

The result of this constraint is that true fully distributed networks are not a reality in the MS network family today, and instead there is generally a distinction between server and workstation processors. A more severe result of these hardware and software constraints is that large efficient servers cannot be MS DOS based and so vendors have had to develop proprietary server hardware and software, which they then try to make MS DOS and MS network compatible. This also should change with the 80386 processors and MS DOS 4 and 5.

While IBM offers both the PC Net and Token Ring and Northern Telecom and AT&T offer MSNET based networks, the current top choice in the MS network family include those from 3-COM, Novell and Banyan. 3-COM is the most MS DOS compatible, and even will be interfaced at the NETBIOS level, but 3-COM has tended to try to market their network on their own Ethernet card. (This is due to the fact that this was the company's origin.) Recent indications are that the software network is now being more agressively unbundled, so it is beginning to appear on many transport systems. Novell and Banyan have always offered their network on other vendors transports and so have more transport options at this time. Novell and 3-COM have focused on smaller networks, while Banyan has focused on larger networks and sub networks integrated over various transports.

The gateways are beginning to appear, but at present the most common gateways are to IBM 3270 and asynchronous ports. They all have message systems and are all talking about, or are just releasing, X.25 gateways. Integration of Macintoshes and TCP/IP do not currently exist, although 3-COM offered a Mac server in an earlier network, while Novell and Banyan are committed to TCP/IP and Banyan acknowledges an interest in the Mac. Banyan appears the most advanced in internetwork bridges, network management and remote management as well as internet standards.

Vendors of applications software for MS DOS are now releasing versions for MS networks and finally are ready to address sight or network licensing and shared programs.

The TCP/IP UNIX family - The TCP/IP network standards were originally developed by the DARPA community but were rapidly and enthusiastically adapted and enhanced by the Unix community, especially those using Unix based high powered workstations and Digital minicomputers. This has thus become the defacto network standard for this class network, and due to its wide spread use has now become the internet standard for academia, and is now moving into industry. This is still a limited commercial market, however, so many vendors are only acknowledging it through gateways from their networks. except for the CAD/CAM area. Some vendors, such as SUN, are also beginning to support servers for MS network based systems on TCP/IP UNIX systems, so some interconnection is beginning.

The specialized proprietary networks - Many vendors offer their own proprietary networks. Some such as Domain from Apollo are excellent, fully distributed, full function networks. Others such as Digital, have indicated a movement to standard networks as they develop. IBM has defined a network based on Application to Application Protocol (AAPC) that is part of its proprietary SNA using a Logical Unit 6.2 (LU 6.2), that is an alternative to the MS network for the IBM PC family.

The OSI networks - The International Standards Organization is working on a complete set of network standards, and most vendors indicate they will move to these standards as they develop.

CONCLUSION

A campus wide network, for a large campus, must use a lower level transport that will get a high speed connection to as many desk tops as possible, from a minimum of nodal points. That transport must support the current network offerings, as well as future ones, and provide high bandwidth interconnection of those nodes. No single offering meets that today, but the Northern Telecom PTE transport seems the closest at this time. Northern needs to add high speed interconnection, cross agreements with major network vendors, and Ethernet and token connection to be fully acceptable. At the higher layer, a combination of TCP/IP networks and MS Networks (such as those from 3 COM, Novel and especially Banyan) would offer many of the services needed. A major weakness would still be the lack of integration, so that the integration of these separate network worlds would be a critical next step.

A LOCAL AREA NETWORK FOR ADMINISTRATIVE USERS

Prepared by

Lynda Barner
Assistant Director of Administrative Systems
Carnegie Mellon University
Pittsburgh, PA 15213

and

Anthony J. Schaller
Manager of Systems Development, Adminstrative Systems
Carnegie Mellon University
Pittsburgh, PA 15213

for

The 1986 CAUSE National Conference
December 9-12, 1986
Hyatt Regency, Monterey, California

ABSTRACT

In 1983 it became very apparent that Carnegie Mellon University was embracing a strategy of distributed yet interconnected computing for instruction and research functions. Concommitantly the central computing resources available for administrative purposes were being stressed with no immediate plans for expanding central administrative computing resources. The need for information and computing support in all the traditional administrative offices was growing. This paper describes the planning for or lack thereof, the implementation of, the care and support of and the lessons learned from the 250 node administrative LAN (Ethernet).

PART I. THE CAMPUS COMPUTING ENVIRONMENT

A. GENERAL DESCRIPTION

Carnegie Mellon University is located in Pittsburgh, Pennsylvania. Comprised of the College of Fine Arts, the College of Humanities and Social Sciences, Mellon College of Science, Carnegie Institute of Technology, the School of Urban and Public Affairs and the Graduate School of Industrial Administration, it offers a computer intensive environment to its 6500 students, 400 faculty and 1900 staff.

Currently, Carnegie Mellon owns in excess of three thousand computers. These include IBM 3083, RT, AT, XT, and PC class equipment, DEC 8650, 11-780, 11-750, 2060, MicroVax and Pro350 class equipment, Sun I, II, and III workstations and Apple Macintoshes. In addition to university owned computers, nearly thirty percent (30%) of the student body own their own computers and over forty percent (40%) of the faculty own their own computers. The University employs over 350 computer professionals, more than 150 of them in support functions.

Administrative computing is supported on two DEC 2060's, three VAX 11-780's, an IBM 3083, the PC LAN, several Appletalk networks and numerous stand alone personal computers. The stated direction is to migrate all administrative applications from the IBM 3083 and the DEC 2060's to an integrated, distributed database environment, operating on a cluster of VAX 8700's running VMS, over the next three to five years.

To reach our goal, we will use mainframes, sophisticated data communications and database management software, high powered personal computer (Microvax, RT Sun III) workstations and local area networking (LAN) technologies to meet information and data processing needs in the administrative areas.

B. THE ADMINISTRATIVE LAN

In the September 1986 issue of *PC WORLD,* Bill O'Brien, a technology writer and computer columnist in New York City, states that the average size of a LAN is 6 to 10 workstation nodes with 20 - 40 MB of hard disk storage, one file server, one print server and two printers and, if unstable, might require as much as 10 - 12 hours of technical support per week. (O'Brien, Bill. "Network Management: Tips and Traps", *PC WORLD,* September 1986: pp. 228- 237.)

Administrative Systems appears to have one of the largest pc based local area networks in the country. In addition to its size, the uses of the network have extended beyond electronic mail, shared printers and shared general purpose software. The Administrative LAN at Carnegie Mellon University, which is the subject of this analysis, has over 250 workstation nodes, 2.5 gigabytes of disk storage on the thirteen file and print servers and 12 printers (including dot matrix, daisy wheel, and laser).

The tarpits between conception and deployment of LANs are numerous and occasionally deadly. We will describe both the current operation and review some of the major issues that were addressed on the way to network stability.

The factors leading up to the currently installed administrative LAN had their roots in four streams that were converging in 1983. First, demands on the administrative DEC 2060 hardware had grown to the maximum level that a single system could accomodate. The decision point regarding additional hardware acquisition was approaching rapidly. Second, the commercial availability of personal computers appeared capable of supporting administrative users. Third, there was a growing need to standardize office automation applications for ease of support and development. And the fourth was the on-going technological thrust of the CMU ambiance.

One of the major differences between this environment and most other institutions of higher education is the tools utilization (technology drives service) emphasis on the part of senior management. Few organizations have the type of technologically based user community among the senior administration that is present at CMU. This environment tends to seek advances in technology to address problems even if these technologies are not completely stable.

Evaluation of the points of convergence of these streams and development of a strategic posture for administrative computing was the responsibility of Senior Vice President Richard van Horn, Vice Provost for Computing and Planning Douglas van Houweling, Director of Administrative Systems J. Ray Scott, Office Automation Coordinator Lynda Barner, and Senior Systems and Technical Analyst Anthony Schaller.

One of the initial decisions made was to halt further applications development in the DEC 2060 arena and to begin the process of planning for the next generation of applications development. The personal computer was proposed to absorb some of the application demand overload. This allowed the use of personal computer technology for the development of interim applications.

The first phase of the plan to meet application needs called for the purchase of several personal computers by administrative departments. To add fiscal support for this direction, the cost that would have been incurred with the purchase of additional mainframe hardware was used to subsidize departmental acquisition of personal computers. This direction was in line with the university's stated policy regarding a transition from a timesharing to personal based computing environment.

As the need for shared access to data became clearer, the advantages of having powerful personal computers for use by individual staff seemed to be outweighed by the need for common access to information and by the constraints that are imposed by multiple versions of files. Other issues that surfaced included the frequent need for printing capability, the requirement for greater storage capacity than provided by standard personal computers, and the expense of the systems that had hard disk access.

After careful examination of the options, it appeared that using Local Area Network (LAN) technology provided many of the advantages of timesharing computing and minimized the disadvantages of stand alone personal computers. We could still meet the intended objectives with the LAN solution, therefore the decision was made to investigate this technology for possible application opportunities in administrative offices.

Planning for the LAN included system specification, vendor selection, product acquisition, location planning, cable and hardware installation, software installation, user training, applications development, planning for enhancements, and planning for replacement. Each of these activities was addressed to a greater or lesser degree in the implementation of the Administrative Systems LAN.

1. SYSTEM SPECIFICATION

The LAN specifications were developed by technical staff from Administrative Systems. Among the specifications were that the technology of choice was the ethernet bus technology. Data transmission rates were to be in excess of 6 megabits. It was desirable that the architecture permit more than one file server on the network. Print queueing and spooling were required. Various access schemes for files - - public, shared and private - - were to be supported. Good diagnostic capabilities had to exist in order to aid problem solving as we entered into an new environment. System software provided by the vendor would indicate the forethought and planning placed into the product.

The system had to utilize standard DOS to assure applications software availability and permit use of all DOS commands. The applications that could be served by the network had to include shared file access, database, word processing, printing, and interdepartmental mail services. These additional utilities would provide services that were previously only available from the mainframe.

It was anticipated that we would expect the same robustness from application software on the LAN as we were accustomed to on the timesharing systems.

We decided to establish a pilot installation to evaluate feasibility, support requirements, and usefulness of the software in a production environment.

2. VENDOR SELECTION

During late 1983, the Administrative Systems technical group investigated various network vendors who were active in the field. These vendors included Orchid Technologies, Corvus, Novell, Proteon, and 3Com. During this period we weighed the stated product directions, compatibility with industry standard protocols, and interest in the CMU environment.

After preliminary investigation the group selected the 3Com Ethernet products for both hardware and software for the proposed pilot.

3. PRODUCT ACQUISITION

Under the agreement formalized between CMU and 3Com, both organizations would benefit from this committment to LAN development. CMU would receive pricing incentives for network interface boards used within the campus and a site license for the Etherseries® server software. 3Com would benefit from the sale of boards, which would increase as additional servers were deployed, and CMU would serve as a showplace for LAN development. In addition, CMU would be permitted access to source code to obtain better understanding of the product and accelerate our network software development.

In hindsight, this agreement was problematic. Although it had provided a mechanism by which we could grow our LAN very quickly, it did not clearly state what our status was with respect to technical support (see Lessons We Learned for a more detailed explanation).

4. LOCATION PLANNING

Location planning for the initial LAN site included selecting an area where the cabling could be installed with minimum user disruption, the server could be housed appropriately, the LAN would receive high usage, and installation of the LAN would add significantly to the efficiency of the operational unit.

The Financial Aid Office of Carnegie Mellon was selected as an appropriate location for the introduction of this technology. This site was chosen for several reasons. They had limited access to mainframe computing and many work requests in the queue; the applications they requested were primarily dependent on data collected by the financial aid office; data involved in the proposed applications, that was not already on the 2060, was not needed by other offices; the unit was centrally located; the applications would have high visibility; and the Associate Vice-President for Financial Resources, Walter Cathie, was a willing and supportive collaborator.

5. CABLE AND HARDWARE INSTALLATION

At the time the initial network objectives were established, the IBM Personal Computer was selected as the hardware environment. The final configuration included one XT to act as the initial network server, four PC's with two disk drives and seven PC's with a single disk drive each. Every personal computer, regardless of type, was equipped with a memory expansion board, 384K of RAM, a Hercules Graphics Card, and a 3Com Etherlink card and appropriate cabling and connectors.

Once the selection of network vendor and the site was made, the installation of the necessary ethernet cabling and connectors proceeded very quickly. The wire was pulled for the first installation in late 1983. Based on the recommendations of external consultants we used the coaxial RG58 cable with screw on connectors. This proved to be a costly mistake. (This will be discussed in Part II. Impact of Exiting Technology on Implentation of the Administrative LAN.)

In addition, personal computers were configured for the departmental staff as network workstations accessing a departmental server for printing and file storage. Each workstation was equipped with DOS and network drivers to enable it to use the network. We also provided standardized batch files for routine operations (ie: logging into the network and linking to data volumes) as well as the 3Com Etherseries® user software.

6. USER TRAINING

User training was conducted on-site. In each of two sessions, small groups of the financial aid staff were trained. The first part of the training involved hands-on practice to introduce and practice login, linking, using the system help facilities, and network services like mail and printing. The second part of the training dealt with the specifics of using the applications programs developed for their use.

7. APPLICATIONS DEVELOPMENT

To facilitate the applications development effort, standards were developed for drive specifications and other network locations that would need to be coded into the application. The initial user application was identified and the programmer analyst who supported financial aid on the mainframe was assigned the PC development effort. This individual also provided user training in the use of the application on the network.

8. PLANNING FOR ENHANCEMENTS

Initially, two types of expansion were foreseen. The first was an expansion of the capabilities and utilities of the network. This was accomplished through the development of additional user applications, batch files, user greets and news messages.

If the pilot was deemed successful, the second type of expansion would involve additional nodes including the applications support group (AS) and other student related Administrative offices (registrar, admissions, student affairs, etc).

9. PLANNING FOR REPLACEMENT

It is important that any projects initiated at C-MU be readily compatible with the ANDREW campus wide network. Future plans include integrating the network into the campus wide token ring network, either through gateways or through a conversion to the token ring hardware and software. Of major consideration is providing the mechanism for a path into the ITC distributed network and maintaining the speed and functionality to which our LAN users are accustomed.

The response to the pilot was extremely favorable. The LAN technology made use of existing data from the mainframe, provided the way to create a richer information context for the financial aid office staff, and provided a model for other administrative areas in the blending of older and newer technologies. It offered a clear transition path to a more distributed data processing environment in administrative offices.

The intensity of this response created some resource allocation problems for Administrative Systems, as other offices began to clamor for the same type of environment and services. (See Part V - Maintenance, Operation and Training Support Necessary to the Successful Life of the LAN.)

PART II. IMPACT OF EXISTING TECHNOLOGY ON IMPLEMENTATION OF THE ADMINISTRATIVE LAN

A. EARLY IMPLEMENTATION DECISIONS AND RATIONALE

As the LAN gained wider acceptance, there was more of a demand for additional administrative units to be connected. Various scenarios and options were weighed in determining the best method by which expansion could take place. Our expansion moved toward a "grow and react" strategy mostly because of limited funds and personnel. Once we reached a critical mass within our LAN in number of offices supported, we were able to resume a more proactive stance. The strategy was developed that would encompass LAN access for all of the remaining departmental units.

During this growth period, there were numerous considerations which impacted the implementation strategy. The costs of the physical wiring was an important factor as was the physical placement of the connections resulting in varying lengths of network segments.

Baseband Ethernet had traditionally operated on thick Belden 8262 cable with costly drop cables that connected to each workstation which was attached. One advantage which the 3Com network offered was the ability to run Ethernet on a thin RG58 C/U coax cable and eliminate the drop cables entirely. This saved considerable cost on the network cable and the drop cables thus reducing the per connection cost significantly. The drawback, however, was that upon considering distance, the thin RG58 cable had a maximum recommended distance of 1,000 feet per segment while the thick 8262 cable could support a 3,000 ft segment (1->3 ratio per foot).

In addition, each cable supported various types of connections to tap into the network. The thick 8262 cable required an external transceiver tapped into the cable with a drop cable running between the network and the workstation. The thin RG58 cable only required a T-connector placed between pieces of network wire with the vertical portion of the T connected to the back of the personal computer. When using thick cable, the drop cable brings the network connection to each workstation, while the thin cable must run by each workstation that is to be connected.

This approach of "tapping into" the network is characteristic of a bus network. Each machine connected to a segment will listen to the cable to see if it is clear to transmit data. If two machines collide while attempting to send data simultaneously, they each wait a random period before retransmitting. Electrically, the bus requires a terminator placed at the both ends of a segment of cable. If a break in the segment of cable occurs, all users attached to that segment are unable to communicate on the network. An advantage to thick cable is that additional users may be tapped into the network without disrupting other users. Adding users to the thin cable requires bringing the network down, cutting the cable, adding connectors to attach to the controller card with a T connector and bringing the network back up.

Another method of connecting close quartered clusters of people is by using a Delni (Digital Ethernet Local Network Interface). This device permits the connection of a drop between the delni and the network, then other drops are connected directly between the delni and the workstation. It provides the advantage of a star network while maintaining the Ethernet specification. One may isolate problems easily by removing drop cables from each of the Delni connected machines until the malfunctioning machine has been detected. Also the addition of a Delni adds no physical distance to the length of the network cable, irrespective of the length and number of drop cables.

In reviewing the original topology of the LAN, it consisted of thin cable running through the Financial Aid department with an eventual connection to thick cable in a pipe shaft. The thick cable crossed between buildings underground and then ran into a wiring tray in the hallway to the Administrative Systems corridor. From that point it merged back to thin cable and ran through the developers' offices. A benefit of the chosen network technology was the ability for one station to be down and not affect other users on the LAN. This aided us in localizing trouble to a particular machine.

An additional segment was added to the end in the Financial Aid office that extended via thick cable to the University Planning Office located on the third floor of the administration building. Shortly afterwards, an extension was added to extend the network onto the fourth floor accounting area.

As the network segment was extended, we found that performance began to degrade as the length of the network went over allowable specification. In order to improve performance, the network was split into two segments, and a repeater was installed between them. The repeater served as an "amplifier" to take data packets heard on one segment and send them onto the next segment. Research into various units proved that Digital Equipment offered a reliable product at reasonable pricing.

Further growth of the network continued throughout additional departments on the second, third, and fourth floors. It was during this period that the decision was made to move to a topology which supported a trunk, running through the center of the building, connecting to segments across floors. Part of this decision was the realization that the Ethernet specification did not support multiple repeaters within a single logical segment. The preferred approach was to have a repeater between each segment of the network and the main trunk.

In our quest to provide good performance for users on the LAN, we found that the server technology was a key factor. Early in the implementation, we proceeded to explore integration of large disk technology with fast access times as a way to overcome the I/O bottleneck associated with normal PC XT disk drives (ie: 140 mb drives with 20 ms access). Once file servers were available we examined their capabilities and limitations.

Surrounding the research into faster hardware, analysis of fast efficent software took place. Out of the search for fast database software, we discovered operations to be more I/O dependent and less CPU dependent. Faster disk controllers and drives would reap more performance benefits rather than merely speeding up the CPU. A sophisticated benchmark was developed for testing hardware and software for comparisons.

In addition, we examined the availability of file and record locking mechanisms to incorporate within our software development. As a key feature of timesharing was the ability to share data files, we wanted to provide this capability. Here again, it had to be fast, reliable and efficent.

B. WHAT WE LEARNED ALONG THE WAY

It would be ideal if all of our choices and decisions were without mishap and the network remained reliable throughout its expansion. Obviously, as in any new endeavor, it was and is not without its problems. We will review the lessons learned and provide some insight as to how these conclusions were reached.

Use the correct equipment:
The network cable was pulled for the first installation in late 1983. The thin RG58 coax was used throughout the Financial Aid department and required connectors inserted for each of the personal computers to be connected. After an initial two months passed, the network was unstable and continued to have intermittent problems. Some further research into the problem revealed that screw type connectors had been used rather than crimp-on connectors. RG58 cable had a braided core which would not support a screw-on connector. In addition, some RG59 cable had been used in error. Connectors were replaced and the bad section of cable replaced.

Due to the initial limited commitment of financial resources for this pilot and our naivete´, most of the initial cable was pulled by Administrative Systems technical staff rather than by CMU electricians. As we began to make use of the electricians, we worked closely with them to identify wiring specifications and they began to physically lay the cable and install runners. Eventually, the data communications staff was contracted to install the connectors. They currently work with us in any diagnosis of the physical cable.

Analyze the cable installation:
Installation of the cable requires a great deal of care. Sometimes it is useful if the group handling the installation knows the impact if a mistake is made. Follow-up is sometimes required to insure tthat the cable was installed successfully or to find and correct flaws.

The trunk cable which ran between the two buildings had been installed by another organization within CMU. Three conduits were available for cable; one was empty; one contained asychronous data communication lines; and one contained power cables. After investigating a potential problem caused by electrical interference (the network tended to go down at 5:10 PM every day), we discovered that the cable had been laid in the same conduit as the power cables. Our thick network cable was then removed and reinstalled in the empty conduit thus ending the mysterious problem.

Adopt a network which uses industry-standard protocol:
In the confusion of various networks available as well as different protocols with claims of faster transfer due to larger packets of data, etc., one must realize that vendors who conform to industry-standard protocols will provide the most flexibility for expansion. A variety of repeaters and bridges from various vendors are available that communicate across those protocols. It is best to invest in a LAN solution that offers a wide variety of choices for the future.

For Administrative Systems, an attractive feature of the 3Com LAN was the XNS protocol that their software used.

Fasten the cable safely and securely:
Many of our problems occurred due to loose cable that had been "tucked" along the underside of baseboards. Frequently this cable would either be tugged by people moving their PCs around, become crimped or rolled over by chairs. Just the process of fastening the wire properly aided in stablizing the network.

Build a common environment for the clients and the software:
As with any computer system, there is a need for a consistent interface for the client community. This accelerates their ability to learn new software as well as understand how to navigate through the network.

We found that standardization of drive letters within the DOS environment helped meet this goal. System software tended to always reside on a E: drive while personal disk areas were on F:. RAM disks were used to insure that both users with and without hard disks maintained the same network drive designations.

Establish naming conventions:
Network servers require that log-in names are assigned to each user on the system. These names should be unique across all servers.

At CMU, users are assigned unique id's for the timesharing systems so it was very convenient to adopt the same names for the network. Servers were given names that were relative to the department for whom they provided service.

Insure that all servers on the LAN know about their neighbors:
When a server goes out of service, it is very easy to disconnect it from the network, perform the required repairs, and then re-install the server without attaching it to the cable. Perhaps the work may take place while the segment has additional connections spliced into it so the cable is unattached to the rest of the network.

Generally we found that if a server did not know about the rest of the servers on the LAN, its user community were not able to see those other servers. This affected the ability to link to other servers for accessing files or spooling prints. It was imperative that we insure when a server went taken down for service, all other servers were notified of the change. Conversely, when a server was brought into service, all other servers were notified of the addition. The 3Com software included a provision for this.

Build network catalog for all nodes:
When diagnosing problems or researching information regarding machines attached to a segment of the network, it is very useful to have it stored centrally within a file accessible by all users.

As the number of machines continued to grow, we updated a file containing serial number of machine, name of the user to whom it belonged, TCP/IP address which was assigned, and other information.

Perform preventive maintenance practices to reduce disk data errors:
Disk management becomes more of an issue when disk size exceeds 10 or 20 MB. The larger disks on some PC based servers require specialized controller software. These disks need reformatting at periodic intervals to reassign bad sectors and to place data in a contiguous area.

There were a number of instances when a server would operate with intermittent success due to a bad sector encountered after 2-3 months of operation.

Partition sizes place boundary on file sizes:
A presupposed advantage of large disks on the PC based servers was that we would be able to create volumes to hold files that were the size of the disks themselves. Unfortunately, due to the 32MB size limitation, we discovered that larger disks were partitioned on the server. Although one could make all of the partitions available for use, volumes for files could not extend across them.

Monitor disk space usage & encourage off-line archival onto floppies:
Based on our experience with timesharing systems, we realized that disk space is probably the one resource which is consumed the fastest. In order to minimize this problem on the file servers and insure that enough space remained for applications to run, we encouraged people to utilize floppies for personal storage. Each general user was assigned 160K of space on the server. Exceptions were made based upon the warranted situation (ie: large databases for statistical analysis, or large spreadsheets, etc.). The mail facility provided a method for users to accept mail that was stored centrally on the server and place it onto a floppy once they chose to receive it from the pool. This was especially useful as the number of electronic mail messages increased over time.

Use repeaters to minimize effect of network maintenance and aid problem determination:
Repeaters linking segments of cable to a trunk provides the ability to easily isolate sections of cable, for adding connections or determining problems on a segment, without limiting access to other servers for other users on the LAN.

Establish a problem reporting & logging procedure:
Problem reporting and problem resolution was initially probelematic. The users tended to report problems to see which ever network technician they saw first or knew best. No records were kept in a systematic way and there was no way for all of the people charged with supporting the network to know what problems had occurred and their solutions unless they were directly involved in the problem resolution. There was also no control to assure timely resolution of network problems. The current mechanism for receiving problem reports utilizes the services of the AS secretary for problem logging, the network manager to allocate resources for problem resolution, and at least two people who can be assigned responsibility for assessing and resolving the problems through repair, referral, or education.

Problems may be "reflections" of one another:
Interestingly enough, when one examines a network via the TDR meter, it is possible to see signal reflections on the cable. At times, when a user experienced trouble with his machine on the network, the actual physical problem could exist with the cable on the other side of the segment. It just so happens that he experienced the reflection of the problem.

Understand what product support is available:
It is imperative that good support is available. Nothing was more frustrating than to have a problem that could not be resolved remotely via a phone call. In addition, having access to local support for parts and repair is critical, especially if there is no spare equipment available on site.

Know the advantages of diagnostic and measuring tools available:
Nothing is as frustrating as trying to diagnose a "ghost" problem that exists within the network. You cannot seem to track it to a particular machine however it is affecting users on that segment. Diagnostic software and instruments are the best tools you can have in trying to combat the network "gremlins."

These are some of the tools which assisted us in our implementation:

Network Spy Programs - These programs are able to monitor packet flow across the network between user machines. Each packet is assigned a type depending upon the type of traffic. The 3Com network uses the XNS protocol. The TCP/IP protocol is identified as another packet type. If a personal computer was transmitted invalid data due to a bad transceiver circuit, it would appear on the spy program. It is also possible to trap a group of packets and examine each packet to insure that it is formed correctly. Obviously these should be safeguarded as the potential exists to trap sensitive data if written to a server while monitoring.

Debugging Mode Within the Network Software - Within the 3Com user software, a diagnostic network program is provided to test the internal network interface card as well as the attached network. This program can act as a server to be used for remote diagnostics against it, or transmit packets for testing purposes against another server on the LAN. This was used frequently to check new segments of cable prior to installing the server or to test the interface card in a machine suspected of having problems.

Diagnostic Scope - A Time Domain Reflectometer (TDR) should be required equipment for network installations. Many problems which stem from faulty connectors, crimped network wire, open wire, distance problems (cable length being over specification), and babbling transceivers can be pinpointed with this device.

Early in the implementation, we sought a sophisticated device to help diagnose the above problems. After some investigation, we discovered that Hewlett Packard manufactured the TDR meter. It not only could locate all of the fore-mentioned faults, but also provide accurate distance measurements of the cable segments for both thick and thin Ethernet cable. This was a major factor in final stabilization of the network.

Provide for power loss & surge protection on file servers:
Power loss on a file server can result in trashed data or worse - total disk failure. Furthermore, spikes in electrical voltage can have a similar effect or cause temporary disruptions in service should the machine reboot.

The servers located in the adminstration building were subject to power fluctuations quite frequently which resulted in machines rebooting during the night. After researching the market for backup power supplies, the PowerMAX® power supply manufactured by Panamax was selected. A critical factor was the switch-over rate during a power failure. If the rate was too slow, it could interrupt the hard drive during a read/write operation resulting in a loss of data.

If affordable, maintain equipment redundancy:
When you rely on systems for production, more than a half day of outage can be disastrous.

We found that it is envitable that disks will fail with no recovery possible. In addition, a repeater may fail resulting in a segment of the network unable to communicate with the rest of the remote population. (Early on we decided to place servers for departments on the same segments as those departments. Then, if a repeater went down the network users would not be isolated from their own server.) Transceivers that are used for drop cable connections to the network can also fail over time resulting in the same problems as a failed repeater. Having spare disks and network components can result in quick uptime for the affected users.

Log all changes to the network:
As the network is expanded or modified, all changes should be recorded. We found that generally if a problem occurred, it usually did after something had changed on the network. After checking the log, the change could be undone and the problem would vanish.

Plan for office renovations and changes:
As organizations grow and change, there are inevitable remodeling and facility changes. Once the network is installed, these changes can severly impact the layout of the network segment in those

areas. Analysis must be performed to understand how the new space will look and if the cable route should be adjusted accordingly. Even if it is possible to preserve the existing path of cable, users on that segment must expect to have down time while the remodeling takes place. If only a portion of the segment is affected, a bypass section of cable can be installed to continue service to the rest of the clients in that area.

Once the remodeling has been completed, the cable should be checked for any damage which may have occurred unintentionally.

PART III. MAINTENANCE, OPERATION AND TRAINING SUPPORT NECESSARY TO THE SUCCESSFUL LIFE OF THE LAN

Networking technology requires technical skills, development skills and maintenance skills. Support issues fall into five catagories: planning, hardware and software maintenance, operations, user training and consultation, and application development. It is clear that any LAN project needs to be addressed by a careful analysis of the activity areas and an allocation of the resources to support the required activities. The administrative LAN currently requires 2.0 FTE for technical and user related support.

The network manager is responsible for the support of the software and hardware that is a part of the network. A network technician is responsible for the operations component of the LAN. Current network maps are maintained, system upgrades are installed and general systems maintenance is performed. The network manager is responsible for the day to day operation of the network including performing regular system backup, trouble-shooting and arranging for user training and consultaion as needed. A trainer/consultant provides user training and support. Applications development and maintenance are primarily the responsibility of applications programmers in Administrative Systems who do not also share network maintenance responsibilities.

Each server area has a user representative designated as server administrator who has local responsibility for the network. This person receives additional training in problem resolution and local support issues. The training of new departmental users in network use and applications on the network use are among the responsibilities of the server administrator.

Another area of support entails the coordination of the server administrators meetings where on-going training, resolution of support issues, and coordination of network wide events occurs.

A. PLANNING

The development of a coherent plan for the stabilization, development, expansions and support of the ethernet is critical. The planning effort needs to be technically sound, administratively feasible and explicitly documented.

To this end standard operating procedures were developed and communicated to the users via the server administrator meeting as appropriate. Procedures for reporting problems and problem resolution fall in this responsibility area.

Research and technology exploration is another aspect of on-going planning. Like other areas in Administrative Systems, the future stability and usability of the network relies heavily on the quality of the research that is done.

On-going needs are for clear procedures, clear technical documentation, and administrative attention to resource allocation.

B. HARDWARE AND SOFTWARE MAINTENANCE

Basic maintenance includes preventative maintenance, trouble shooting, problem reporting, referring for action, and dispatching of resources. Upgrades to network system software must be scheduled and tested prior to actual deployment.

The mechanism for receiving problem reports is in place. This is an area of high exposure. The appropriate operation of this area utilize the services of the AS secretary for problem logging, the network manager to allocate resources for problem resolution, and at least two people who can be assigned responsibility for assessing and resolving the problems through repair, referral, or user education.

C. OPERATION

Operational issues include file transfer, disk backup, and file restoration requests.

Production systems require a high degree of data integrity on the network. Some also handle large scale file transfers to or from the 2060 and vaxes and the network for manipulation or inquiry by local users. Systems that rely on local data entry are especially vulnerable to data loss. The standard established for the network is that no more than one day of data will be lost due to network or disk failure.

An automated system for backing up all servers operates via the BACKUP server located in the UCC building. We make use of two types of backup, full and incremental.

The weekly full backup copies all files on the server onto tape at a pre-set time. Full backups are scheduled during the night to assure that all files are closed during the backup. All files are backed up even if they have not changed since the last backup was performed.

Incremental backups copy only the files which have changed since the last backup to tape. This insures that volatile data is saved to tape on a daily basis.

Through these two methods of backup, we can recover from almost any disaster. If the disk drive on a server goes bad, we can restore all files to a new disk. (See "What we learned" for caveats.) This insures that the maximum data which can be lost is the changes that occurred since the last backup (full or incremental) was performed. Back-up tapes are kept for a month.

With the automatic remote backup method, it is not necessary to take down the servers while either incremental or full backups being performed.

D. TRAINING

Training and support are offered by a group of four; two technical staff, one trainer consultant and one manager. Training is provided to users of the network in three parts. The first part of the training involves a lecture and demonstration of basic networking issues. Terminology specific to networking is introduced and general concepts such as volumes, users, and working in a shared environment are presented. The second part of the training involved hands-on sessions to introduce and practice login, linking, using the system help facilities, using the network services like mail and printing and using shared software programs. The third part of the training deals with the specifics of using the applications programs developed for the administrative unit.

In addition to user training, on-going technical training for the ethernet technical support group is provided.

E. APPLICATION DEVELOPMENT

Since the programmers who do applications development on the LAN have typically come from mainframe development environments, it is important to communicate appropriate parameters for application development. The application engine is still a PC or AT and, as such, has limitations that are to be expected with the compute capacity and I/O constraints of current PC and disk technology.

PART IV. DETAILED TECHNICAL DESCRIPTION OF THE LAN

The network is comprised of thirteen servers (one VAX 11/780, three 3Com 3Servers, one AT, and seven PC/XTs) and over 250 PC, XT and AT nodes. The cabling is a combination of RG58 C/U Coax cable and Belden 8262 cable. Both in-line and vampire transceivers (3Com and DEC) are used on the LAN for attaching drop cables. Four buildings are included in the present network topology.

Servers are equipped with various dot matrix, letter quality, and laster printers. Software based on various servers range from various database packages, spreadsheet and pop-up window software, to terminal emulation software for accessing the mainframes. Applications written with COBOL use network subroutine libraries for semaphore locking on the servers.

The XNS protocol is used by the 3Com Etherseries & 3Plus software. Network users are able to attach to the mainframe using TELNET teminal emulation software across the network using the TCP/IP protocol. File transfer is also possible across the LAN from the mainframe using FTP. This utility also uses TCP/IP protocol and only transfers to/from a non-network disk. Those users who also have asychronous connection to the mainframes use KERMIT for terminal emulation and file transfer.

The administrative ethernet is connected to the CMU campus network through a network router. This device isolates traffic destined only within the administrative LAN to remain there and pass other packets of data on to the destined LAN on campus. The remainder of the networks on the campus consist of both IBM Token Ring and Ethernet with fibre-optic links.

PART V. IDENTIFICATION OF ADMINISTRATIVE OFFICES, FUNCTIONS AND APPLICATIONS BEING SERVED

Carnegie Mellon 's central administration is comprised of five major responsibility areas, each reporting through a vice president. The academic groups report through a provost and a vice president. The administrative vice presidents direct the activities in Business Affairs, University Relations, Alumni and Development, Enrollment, and Computing and Information Services. Offices in each of these responsibility areas use applications on the LAN.

Applications common to all servers include support for word-processing and printing, local database access, data entry, report generation and mail services. Each area also has access to applications specific to their business. Applications make use of programs like Lotus 1-2-3 and or word processing packages, or are based on database packages or are coded in third or fourth generation languages.

Some examples from Business Affairs include the student accounts receivable cash entry system in the cashier's office, the applicant tracking and retrieval system and the temporary employee services system in the personnel offices, and the purchasing, encumbering and payables system and accounts payable systems from the accounting office.

Examples from the Enrollment Division include Career Services Campus Interviewing application, commencement system and academic audit in the Registrars Office, Student Aid and Sibling Verification tracking systems applications in Financial Aid, and some enrollment analysis applications which identify why applicants who request information on CMU do not apply or who were accepted at CMU and choose to go elsewhere.

University Relations applications include an automatic news release application notofying home town newspapers of student honors and milestone events, the faculty biography profiles, the media coverage system and the media backgrounders applications for Public Relations.

For the Development Division, Alumni and Individual Giving are supported by the telemarketing application.

Computing and Information Services are represented by Work Order Tracking and Retrieval systems for Administrative Systems and other analytic applications for the Institutional Planning Office.

PART VI. THE FUTURE OF THE LAN -- TECHNOLOGICALLY AND ADMINISTRATIVELY

The current LAN, as well as the larger campus network must meet the stated objectives of providing distributed production capability, the ability to grow at the local level, and develop additional computing power. It must be responsive to end user computing requirements while recognizing the changing face of central computing resources. As users move from timesharing we must continue to lead the way for expanding user resources at lower cost.

In the future, the LAN will play an important role in the new distributed information systems that are developed. It will continue to serve as the access mechanism for users to get at their data. As information will be distributed across machines, so does the potential for a split-second interruption in service. The potential rises with the number of networks interconnected between those machines. Successful access for updating and retrieving data in that environment will depend on the ability of the software to maintain integrity of the data.

The integration of the development being done by the Information Technology Center on the Andrew project, the fiber optic campus wiring being supported by the Telecommunications office, the installed base of IBM and MacIntosh personal computers and Appletalk and ethernet LAN's are all entities included in the planning process. The end user access to departmental, university wide and external databases, to the system utilities and to the computing core are important considerations in the continuing network strategy for Administrative Systems.

PENN STATE'S INTEGRATED TELECOMMUNICATIONS AND TELECONFERENCING NETWORK

David L. Phillips
Director of Video Communications Services
The Pennsylvania State University
University Park, PA 16802

The Pennsylvania State University is the land-grant institution for Pennsylvania with campuses in 22 convenient locations throughout the Commonwealth. As "one university geographically dispersed," Penn State has the potential for massive communications problems. Its Telecommunications Strategic Plan recommends an integrated organization and an integrated network for telecommunications. Specifically, for communications with remote campuses, the Plan calls for T-1 carriers, using half the 1.544 mb/s capacity for voice and data, the other half for compressed video. As demand for data communications grows, the number and speed of circuits required can, in many cases, justify the cost of the T-1, thus giving video a "free ride."

The Pennsylvania State University is the land-grant institution for Pennsylvania. It has teaching, research, and public service responsibilities throughout the Commonwealth of Pennsylvania.

To carry out its land-grant mission of accessible education, Penn State has developed a system of 22 conveniently located campuses. Headquarters is the University Park campus in the town of State College in the center of the state.

In addition, the University is responsible for the management of the Cooperative Extension Service with offices in each of Pennsylvania's 67 counties and Agricultural Research Stations in five locations.

It views itself as "one University geographically dispersed." That means that faculty of the total University are represented in a single Faculty Senate with responsibilities for the complete academic program of the University. Each faculty member is a member of a discipline department that is based at the University Park Campus. Admissions, record keeping, housing and food services, library services, computer services, and other academic and administrative services are, for the most part, centrally planned and administered.

This geographic dispersion creates unique communications problems for Penn State. For several years, units of the University have increasingly used telecommunications technologies to meet these communications needs, but until recently this development was mostly ad hoc and uncoordinated.

In October of 1983, as the breakup of AT&T was imminent and telecommunications was advancing rapidly, the President's Office created a Telecommunications Task Force to study the problems and opportunities these changes presented in the context of Penn State's system-wide needs. The Task Force, representing voice, data, and video interests, presented its Strategic Plan for Telecommunications in October, 1984, after an intensive year of work. The Plan recommended how the University could best approach its changing telecommunications environment.

The internal review showed that Penn State is served by a variety of telephone systems across the Commonwealth. The serviceability of these systems varies greatly; at the time of the study -- and yet today -- many require upgrading. Changes in government regulations make it possible for Penn State to think of buying its own voice switches (PBXs) rather than using the regulated facilities of the Bell System and other companies and paying tariff charges. This means that the University can place similar switches in all locations to maximize the capabilities of its statewide network. All the switches could communicate with one another and provide common services throughout the Penn State system.

There are four major central data processing facilities within the Penn State system; all are located at the University Park campus.

The Computation Center provides computing facilities and support services for the instructional and research programs of all academic departments and all campus locations. More than 4,000 graduate students and faculty involved in research and some 17,000 students doing class assignments use Computation Center facilities in any one semester.

For the Commonwealth Campuses -- our "branch campuses" -- access is provided by a growing number of 9,600-bit-per-second leased lines; within a couple of years, there will be an average of six to each of the 21 remote campus locations. Each line uses a statistical multiplexer to permit as many as 32 terminals to communicate with the Computation Center. These lines are shared by other data services.

The Management Services Center supports the administrative computing needs of the University. Its new Administrative Information System (AIS) is a closed system that provides interactive information capability to all campus locations. Some 1,200 terminals are planned for this system. Among other things, it streamlines the student application and enrollment process, automates student registration, and permits "drop/add" transactions to take place by telephone.

LIAS, the Library Information Access System, integrates all current bibliographic information functions and services of the University Libraries at all campuses into a single computerized system.

A LIAS terminal (or dial-in microcomputer) can search through millions of bibliographic records in seconds to make available to the user the total resources of the Penn State University library collection statewide. LIAS is now beginning to add bibliographic access to other university and commercial database services and national library networks.

The Pennsylvania Extension Network of the Cooperative Extension Service serves 67 county Extension offices, four Regional Extension Offices, and five Regional Experiment Stations. At each location, a microcomputer has been installed that communicates through the inter-campus network to a dedicated data processing facility at University Park. Auto-answer modems at each county office enable Extension Service clients to enter the network directly and receive solutions to specific problems or to access databases of significant information.

Later this fiscal year, the Pennsylvania Department of Education and hundreds of school districts will begin using the system for their own purposes.

All of these data support services are growing at remarkable rates, consistent with the pattern seen at other institutions and businesses.

In video, The Pennsylvania State University has been a leader in the development of instructional media and telecommunications since the early work of C. Ray Carpenter on the effectiveness of film and television as teaching tools. In 1952, at University Park, Penn State built the country's first on-campus closed circuit cable television system.

Today, the live classroom system uses one-way video to teach some 900 students in 27 classrooms with live interactive audio from each of the sites under the instructor's control. The Division of Media and Learning

Resources continues to be very active in the production and delivery of instructional materials.

The University's partnership with the Pennsylvania Educational Communications Systems (PECS) makes televised courses available to more than 700-thousand cable subscribers throughout the Commonwealth of Pennsylvania.

On campus, students can gain access to audio recordings of classroom lectures, supplementary instructional materials, or more general information through a Dial Access audio system or through TIPS, the Telephone Information Program Service. Available through special telephone lines or regular dial-up telephones at University Park for years, these services are now being extended to students at other campuses.

Penn State also operates its own public broadcasting station, WPSX-TV, broadcasting to a third of the state on Channel 3. Its weekly current events series for fourth, fifth, and sixth graders is seen by a million school children across the country.

As in data and voice, the demand for audio and video services is growing throughout the Penn State system, as it is in institutions and corporations throughout the country and the world.

The Telecommunications Task Force reviewed external pressures, such as the breakup of the Bell System, substantial deregulation, and dramatic advances in telecommunications technology, and looked at Penn State's growing needs for improved information services, then opted for an approach that integrates voice, data, and video communications. During the period of its deliberations, exciting new developments in compressed video were surfacing that seemed to fit right into the Task Force's planning.

The Strategic Plan argues that: organizationally, it is more efficient to have a pool of engineers than to have several individuals scattered among several units; installing cables together to serve voice, data, and video needs is much more economical than pulling them separately and at different times; for communications between Penn State locations, integration makes possible the leasing of high bandwidth -- in this case, T-1 -- circuits at bulk prices rather than leasing several individual lines for different purposes.

T-1 circuits have been available for use outside telephone companies only for a relatively short time. A T-1 circuit can carry the equivalent of 24 digital telephone lines -- 1.544 megabits per second, counting control overhead.

The Administration accepted the basic premises of the Task Force Plan and in February, 1985, established a new Office of Telecommunications with the mission of creating an integrated network for the transport of voice, data, and video information between and within University Park and the other 21 campus locations. As mentioned, one of the key recommendations was the use of high-bandwidth (T-1) carriers between University Park and each of the 21 other campus locations. Voice traffic would become a local call to the University Park Centrex, and from there would jump onto the state's private network or onto the public switched network. Data traffic would be on 19.2

kb/s circuits at less cost than the present 9.6 kb/s lines, and there could be more of them. And the availability of half the T-1 for video made it possible to think about the new administrative tool of compressed video conferencing. If half of the T-1 can support voice and data needs -- and if those uses could cost justify the T-1 when compared with individual lines -- then videoconferencing using compressed video could use the other half of the circuit virtually for nothing.

One of the major projects in the last year has been to establish a prototype T-1 carrier between University Park and Penn State's Behrend College in Erie, Pennsylvania, using AT&T service.

The choice of Behrend was based chiefly on their administrative needs, although they have a very heavy demand for data communications, as well. The Task Force found that one-and-a-half administrators, on average, from Behrend were traveling the 200 miles to University Park on nine out of ten working days, a four-hour trip each way. That meant that the University was losing 13.5 man-days every two weeks -- 350 per 260-day-year. It was felt that video conferencing could reduce this travel time dramatically, although certainly not eliminate it. Anticipated data growth, both academic and administrative, promised to make the financial equation advantageous.

Later, the instructional media staff in the Division of Media and Learning Resources became interested in seeing how compressed video can be used for instructional purposes. Credit courses, a series of breakfast seminars on high-tech for business and industry, employment interviews, and staff development training sessions from University Park have been conducted in the two semesters the video link has been available.

Another T-1 prototype is being planned for next summer between University Park and the University's Hershey Medical Center 100 miles away, using an alternate vendor, Pennsylvania Educational Communications Systems. PECS is the private microwave system built by cable operators for the express purpose of delivering credit and non-credit courses to subscribers' homes, as mentioned earlier. PECS is now interested in building upon its basic system to provide the kind of communications services Penn State needs. The Hershey prototype is being driven by instructional needs rather than administrative. Genetics and biotechnical departments are at University Park. Instructors there teach at the Medical Center and physicians from the Center travel to University Park to teach.

The University's Budget Task Force -- the people who allocate central funds -- have added to the basic prototype budget enough money to purchase two codecs manufactured by Compression Labs, Inc., known in teleconferencing circles as CLI. (Codecs are "coders-decoders," the special-purpose computers that create smooth motion video with less than one per cent of the original information.

The decision to use CLI equipment came after visits by skeptical Task Force members to various shows and demonstration sites to see compressed video equipment in action. Besides CLI, vendors contacted included NEC America and GEC McMichael in the T-1-type equipment, WidCom in 56 kb/s speeds, and Colorado Video in slow scan. Early on, the slower technologies with more or less jerky motion were judged not appropriate for the kinds of administrative and instructional applications we were contemplating. Judgments were more difficult among those that operated at T-1 and half-T-1 speeds.

For those of you who are not familiar with compressed video, let me offer an oversimplified explanation to help you understand why it wasn't easy.

A standard analog television signal in the United States is nominally 6 megaHertz wide. That means that its transmission requires 6 million cycles per second. Compare that to a high-fidelity audio signal, which takes 15 thousand cycles per second, or 15 kiloHertz. A regular telephone line operates at about 4 kiloHertz.

Today, though, digital technology is changing how we are able to do things. The television signals coming back from space flight are digital, not analog. That 6 megaHertz television signal would translate into 90 megabits per second of digital signal -- 90 million bits of information per second needed to reconstitute the individual frames of that high quality television signal to maintain the same smooth motion and picture quality. If you were to force it through a transmission medium not able to transmit that fast, then either some of the information would be lost -- picture quality would degrade -- OR it would take longer to send all the bits and to build up each frame, so the motion would become jerky.

Various companies have found different ways to accomplish essentially the same thing: create a computer program smart enough to send only the picture elements that change from frame to frame. In a conference setting, with a camera staionary on two or three people, the wall would not change and the table would not change and most of each person would not change. In fact, they discovered that, on average, only about 10 per cent of a typical conference picture changes from frame to frame. That means you only have to send 10 percent of the information: 9 million bits a second instead of 90 million.

But a T-1 carrier is only one-and-a-half-million bits per second. So algorithms were devised that could predict movement: if points A, B, and C show movement in a particular direction, then the system assumes that points D, E, and F will continue in the same direction until the receiving machine is told differently.

These programs are immensely complex -- some run at 200 million operations per second -- but that's the general idea in very simplified form.

A crucial question is: what happens when movement actually exceeds the available bandwidth. Maybe the discussion gets heated and the conferees start swinging. One approach is to maintain picture quality by allowing motion to become somewhat jerky. A second is the opposite: preserve smooth motion by allowing picture quality to degrade slightly in specific, planned ways. CLI is one vendor that uses the second option and preserves smooth motion. We felt that was preferable in our applications. We were also able to work out a very attractive arrangement that allows us to gain experience with compressed video technology in an educational setting. We've been told that Penn State was the first university to use two-way interactive compressed videoconferencing, either for administrative purposes or for instruction.

Since Penn State started trying out CLI's half-T-1 video, other vendors claim to have developed the technology to provide what is called "full motion" video at 56 kilobits per second so it can be transmitted on a standard digital telephone line, such as AT&T's new Accunet Switched 56 service. Even though we will not have access to that service for several years, Penn State is talking to these vendors and hopes to become a Beta test site for one of them this winter, using the 56 kb/s channels available on the prototype T-1 circuit, which employs digital techniques.

Meanwhile, in late Fall, Bell of Pennsylvania filed a new tariff request to offer 56 kb/s dedicated lines within the Federally defined service areas known as LATAs. This intra-LATA service is priced very attractively as a replacement for multiple data lines now being used.

This has led the Office of Telecommunications to begin planning to use a regional communications hub approach rather than the T-1 star network proposed by the Telecommunications Task Force. Campuses within a region would be connected by 56 kb/s lines to a central point, which then would be connected with University Park through a T-1 carrier.

To test multiplexing and networking equipment from different vendors, a prototype with 56 kb/s lines from Altoona and DuBois campuses back to University Park is being proposed as a preliminary to installing the first regional hub next year. If the timing works out, this could also give us a vehicle for a Beta test of 56 kb/s compressed video codecs.

Another consideration in videoconferencing is the room being used. For years, the early pioneers have emphasized the need for specialized conference rooms that optimize video and audio quality as well as ease of use. These can easily cost a quarter to a half million dollars or more.

More recently, creative manufacturers have developed "rollabout" units that incorporate fixed cameras, monitors, and codecs. They are designed to work in "regular" conference rooms, meaning those without special "conditioning" for video and especially audio.

Because of cost considerations, and because Penn State has very good existing video facilities, the decision was made to begin the prototype with what we already have available. One of the television studios is converted for each instructional application into a simulated classroom. Special tables and chairs were purchased for this purpose. Trial administrative meetings are conducted in much the same way. There are drawbacks to this approach.

One real disadvantage is the heavy manpower requirement for a manned television facility. A second problem is the lack of privacy when a television crew is on hand. Clearly, the President won't conduct confidential discussions over the system as it is now constituted.

Two newly converted facilities are now being planned. These would be smaller rooms with some automated camera gear, but they will still not be the fully automated rooms being used in some commercial applications.

Our experience with the Behrend T-1 and particularly the video conferencing has been very encouraging. Faculty, students, and administrators by and large react favorably to compressed video conferencing. No special training sessions were conducted, although instructional designers and television specialists worked with the instructors, as they would for any televised course. After a very short acclimatization period, people begin to work with the interactive system in a very natural way. There has been no indication of rejection because of the quality of image or motion characteristic of the compressed video, and there has been a very positive reaction to the convenience and accessibility made possible by the system.

A new unit called a "desktop workstation" offers promise for most one-on-one or small-group administrative conferences. These have a color camera and a microphone and speaker built into the color monitor housing. The newest of these combine speakerphone, PC display, and voice-switched video into small, easy-to-use, and affordable packages. We expect to have units from two different vendors for trial within the next few weeks. Units like these, coupled with the low transmission costs of 56 kb/s lines, will go a long way toward popularizing videoconferencing and video instruction.

Because it is dispersed across a state, Penn State can justify these kinds of telecommunications technologies now, but as prices come down, there will be attractive opportunities for institutions that are only spread out within a city or even scattered across a large campus area. It is another example of how voice, data, and video technologies are converging and making possible new and better ways of communicating information, which is the heart of what our institutions do.

--END--

LINKING COLLEGE COMPUTING RESOURCES

1986 Annual Cause Conference

Monterey

Thomas Warger, PhD
Director, Academic Computing
Bryn Mawr College
Bryn Mawr, Pennsylvania
(formerly at Union College)

David V. Cossey
Director, Computer Services
Union College
Schenectady, New York
(518) 370-6293

Presented by : Mary G. Coates, Manager Administrative Computing Services
Theresa A. Pardo, Coordinator Academic Computing Services
(Both of Union College)

PROFILE OF UNION COLLEGE

Union is a selective, independent liberal arts college with a division of engineering. With an enrollment of approximately 2,000 students, a faculty of 160, and a 100-acre campus, its profile is clearly that of a small college. Yet the spectrum of academic applications is anything but small. Computer Science and three engineering departments consume the largest share of central computing resources, but faculty and students all across the curriculum are quite active and make increasingly specialized demands for computing service. A project team in the humanities has been developing computer-aided instruction modules that it now wants to implement in courses. Faculty in the social sciences are pressing for customized data-extraction software for use in their research, as well as for class assignments. A number of professors in the natural sciences are asking that their formerly micro-based applications be extended to make use of the central minicomputers. Obviously, these calls for service constitute a diverse and complicated set of processing and communications challenges.

In 1981, at the directive of its president, Union committed itself to a major build-up of computing facilities. Without much fanfare, the college had in fact made a strategic decision: to build unusual strength in computing so as to bolster its ability to recruit students and faculty in an era where the technological supports for the curriculum were becoming increasingly important in the competition for both of these classes of people. A five-year, five-million-dollar plan was drawn up and has since been carried through to this, the final year. Computing and network capacity is now quite strong: a cluster of five DEC VAXes for "General Curricular" support, another VAX and several AT&T 3B2's in a Computer Science Laboratory, and various departmental minicomputer and microcomputer facilities providing a considerable stock of processing cycles. A statistical laboratory with a MicroVAX, microcomputer workstations, and access to the central cluster is scheduled to come online this winter, adding significantly to the resources available in the social sciences.

But for all the readily apparent growth in the number of processors, it is probably the investment in networking capability--which is largely invisible to users--that is emerging as the most critical aspect of the computing environment. While not a major focus in the original planning, the linking of devices has become the dominant theme as the plan draws to a close. In fact, the remaining issues to be resolved in the last major project under development (the automation of the campus library), have to do with network connectivity and compatibility.

THE MULTI-TECHNOLOGY NETWORK

For the purposes of this presentation, "network" is used to mean a system of mediated links between computing devices. The connected networks at Union, known collectively as GARnet/UC (General-Access Resources Network) includes three distinct technologies. The host-to-terminal needs for most of the academic and administrative buildings are served by a data-switched RS232c network. A Develcon dataswitch allows users to connect to their choice of several central computers. The physical connections are made over twisted-pair copper wire cable that is terminated at either end by an RJ-11 jack. Line boosters ensure that the 9600 baud signal does not degrade over the sometimes lengthy cross-campus routes.

Since this September, 750 dormitory rooms have been connected to the VAX cluster on a Direct Memory Access LAN from Xyplex Corporation. Here the transmission media themselves are mixed. The signal leaves the dorm room via twisted pair, is routed through coaxial feeders from each floor of the dormitory to a point in the basement where it is converted to a light signal for inter-building transmission over fibre-optic lines. At the computer center, the DMA switch both routes signal and serves as a front end for the VAXes, handling I/O in blocks instead of the character-interrupt mode that is the achilles heel of VAXes. The cost per connection is much higher than in the RS232 solution, but it has been bundled with the new telephone installation that was done at the same time. Each dorm room has two RJ-11 jacks: one for data and one for phone--which is switched by a PBX. While the anticipated improvement in system performance is not calculated as a cost-savings, it should improve the quality of the college's investment in the VAXes.

The third networking technology consists of several implementations of Ethernet. The VAXcluster is itself a DECnet linkage among VAXes, a cluster controller, and shared storage media. A second segment running DECnet extends in two loops through the science and engineering buildings in order to serve those sites anticipated to require high-speed and high-volume transfers of data. This technology serves host-to-terminal connections but is destined primarily for computer-to-computer links. Its first implementation has been in the Mechanical Engineering Department. Within the Computer Science Laboratory (an all-Unix environment) Ethernet will be use to link the various microcomputers to a VAX 11/750 and connects that VAX to the DECnet backbone.

These three technologies represent partial solutions, each at its own price/performance ratio, to meet parts of the over-all need at the College. They represent reasonable options in three of the leading transmissions without necessitating an exclusive focus on one or the abandonment of existing cable plant. While the RS-232 network may be reaching an economic breakpoint beyond which further investments might not be wise, it is expected to give good service for years to come. The Ethernet topology is well-suited for the kind of incremental expansion that is likely to occur, departments and faculty members obtain the funding to tap into the backbone and connect their computers to the network. The DMA LAN, on the other hand, has the benefit of being a one-time expense for installation. While it was costly to put in, it reached all anticipated points of service on its first day of operation.

The most interesting outcome of these efforts in networking is the diversification of environments in which computing is done at Union.

UNION'S SEVERAL COMPUTING ENVIRONMENTS

The base of computing at Union continues to be the computer center. The VAX cluster and the public-access terminals are still the most visible forms of computing on campus. They represent the largest fixed base of resources and the focus of most of the support provided by the center's staff. No hard information exists to show what percentage of computing at Union is done in this environment, but it is probably safe to say that as a share of the total, it is losing ground to two others: departmental facilities and single-user stations.

Public-access facilities, consisting predominantly of terminals available on a first-come, first-served basis represent the the continuing presence of the time-sharing form of computing and the primary means of access for students. These devices are reasonably plentiful and convenient--virtually unused at low points in the daily schedule but swamped during the the last week of the term and even during the mid-term exam week. The work environment at these sites is cold and impersonal, compared by some to bus stations. Students comfortable with computers appear to complain less about this quality; students less sure of themselves or less at ease with computers tend to find it inhospitable. Faculty and administrators would rather do without computers than work in these conditions.

A second envriironment that is growing rapidly, and will probably rival the public-access domain in the future, is the departmental, or "satellite" installation. These have evolved from remote terminal clusters and collections of stand-alone micros to sites with a local host, attached workstations, and network access. The first to implement this configuration was the Computer Science laboratory. The growth of general academic computing inevitably comes into conflict with the special, resource-intensive activities of this academic discipline. It appeared logical to buffer this contention by creating a dedicated environment for the CS curriculum and research computing. The question of the appropriate operating system for advanced work was immediately resolved: the CS lab would be an all-Unix environment, while the public systems would remain VMS. The management of the systems and the monitoring of usage characteristics is directly under the jurisdiction of the CS faculty, functions that would have been prohibitively disruptive for them to do on the public system. Perhaps most importantly, the single-discipline focus of the facility has proven to have educational benefits. The know-how concentrated in the facility at any given time is much greater than in public-access places. And, faculty feel at home in this environment, as well. Students and faculty working at adjacent workstations makes informal, educationally useful interaction easy. The students frequently say how much they appreciate this way of working.

This winter a Statistical Laboratory operating on much the same model will open.

Although Union has elected not to require students to purchase microcomputers and has not provided every faculty member with a workstation, many students and faculty already work in private on a device uniquely at their disposition. Privacy is of course the environment of choice for most academic work. Until recently, only administrative and staff workers were likely to have a terminal or workstation at their usual desk--and in many cases it was put there without their advice or consent. The data-switched and DMA components of the network now reach virtually every workspace on campus, with the exception of most of the classrooms and the library carrels. Students in the Graduate and Continuing Division typically dial into the data switch from their homes or offices. For people working in the private environment, the network becomes a utility like electricity or water, and the computer center is as invisible as a pumping station The principal disadvantage of this environment is of course that support is not necessarily close at hand. Phone calls from remote locations already occupy a substantial portion of the Users Services staff's time and could grow to even higher demands as more students take advantage of the dormitory connections.

PROBLEMS

The new challenges for Users Services are only one example of how distributed computing in the environments described presents problems that were not as severe in the traditional setting of the computer center. There are in fact several kinds of personnel costs that tend to get overlooked. The installation, repair, and mangagement of networks are typically tasks added to the responsibilities of existing staff without thought to the time and new expertise they require. While the operation of computers themselves has been streamlined and simplified over the past two decades, networks have not yet matured to that state. Technicians trained to install and repair computers are not automatically qualified to do the same for networking devices, yet this often the management's expectation--and has been the case at Union.

The growth of networks shifts the computer center's focus of attention from computing devices to the supply and maintenance of data connections. The College still receives numerous surveys asking how many terminals, microcomputers, printers, etc. it has. The answer is that we don't really know anymore. While keeping an inventory of devices "belonging" to the computer center continues as a responsibility, it is difficult to keep track of those owned by departments, grant-funded projects, or individuals. The question is equivalent to asking the water company how many bathtubs it fills. A critical capability we will need to develop is a means of actively monitoring the status of the network: it is embarrassaing to learn from the users that a connection has gone bad.

Diagnosis and repair seem to be inherently more complicated and frustrating in a multi-vendor environment. Occasionally the vendors' repair technicians will insist that any elusive problem must be in the next vendor's segment of the network. The issues range from hardware handshakes to subtle incompatibilities in data communications protocols.

But the most pervasive problem accompanying the dispersal of the users throughout the various environments is that they have virtually no overview of computing activities or of the amount of resources they consume. An expanded bi-monthly newsletter, with sections devoted to the sub-communities of users has been instituted to address this problem.

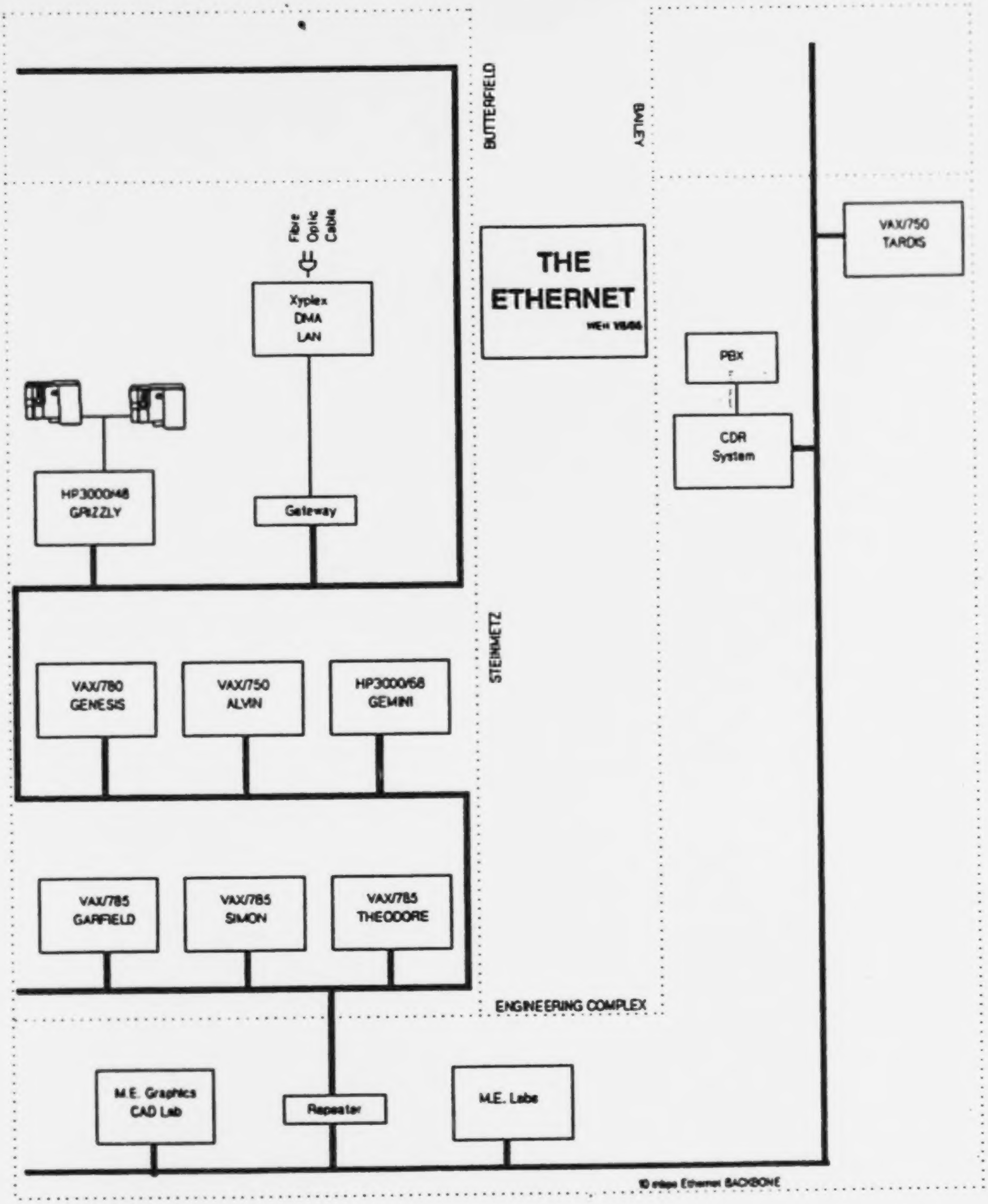
The benefits of GARnet's diversity are, however, considerable. The system is highly flexible, able to accomodate such varied applications as the single-user minicomputer, micro-based wordprocessing, timesharing, and remote host-centered facilities. Where two years ago, there was much discussion about institutional choices in hardware acquisitions, the focus has now moved to one of network connectivity. Decision-making on applications-specific issues can now be done at the departmental or end-user's level. The educational benefit in this flexibility is that the users have much more latitude in choosing the form of computer support that is the most appropriate for their work.
All of computing is increasingly end-user driven: the multiple environments offer a better chance of meeting the diversity of calls that we see.

From the College's planning and funding perspectives, GARnet is easily expanded, modified, or replaced in segments. An obsolete minicomputer can be swapped for a new one without having to change much more than a single box. Local area networks can be added as project funding permits. And the inconvenience due to failure of a single device is more easily localizable. Basically, the variegated network more nearly matches the nature of the academic workplace than did either the timesharing or stand-alone configurations.

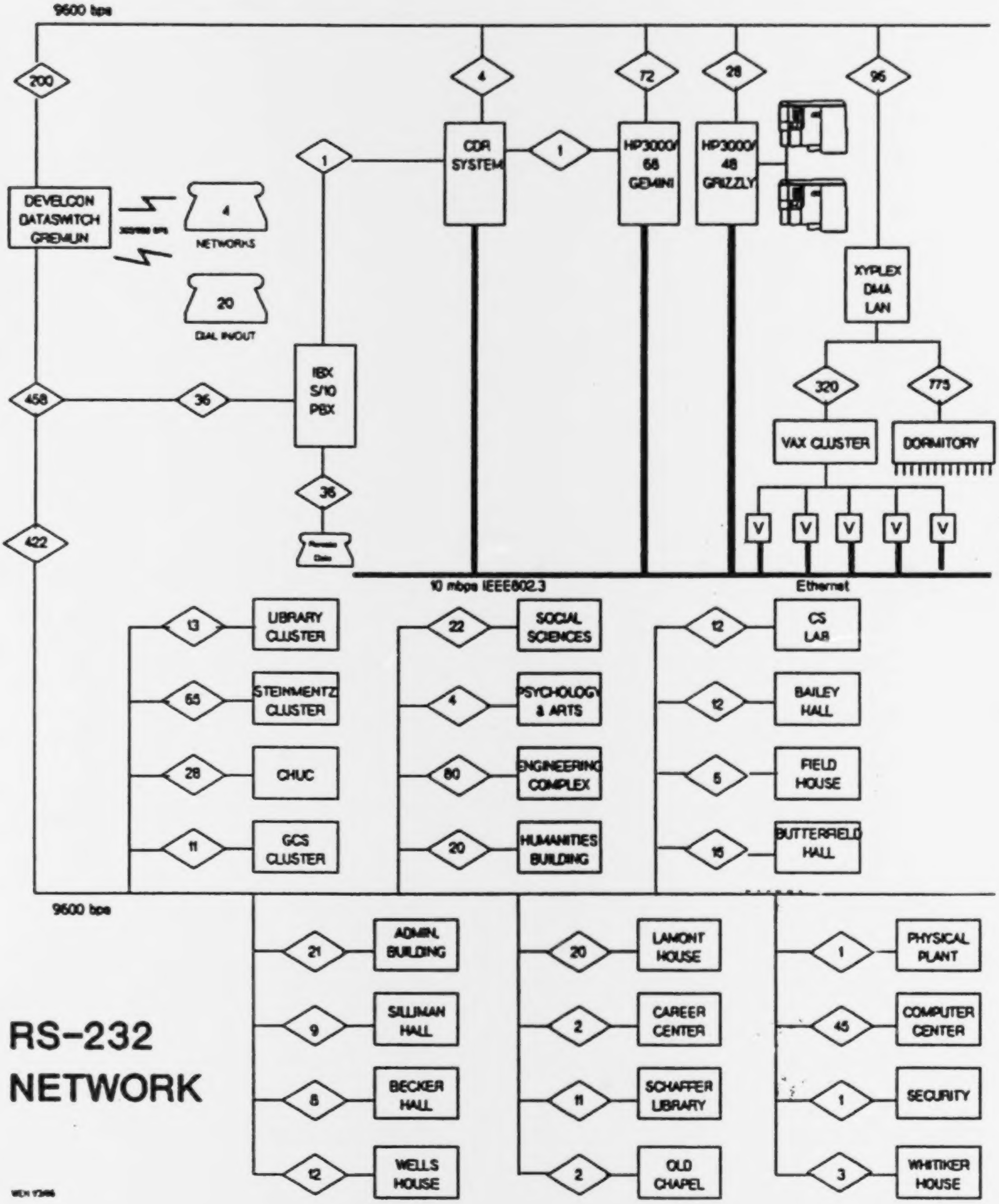
To many at Union, the biggest pedagogical innovation encouraged by the newly computer-intensive surroundings is the opportunity to explore new kinds of collaborative work between faculty and students. Student programmers have worked with faculty in a number of disciplines. Student consultants at the Computer Center serve in some situations as teachers to both students and faculty. The long-term potential in these new forms of interaction look promising but cannot be assessed yet.

With the golden age of spending on computing passed, or at least in eclipse, the multi-technology network offers the best means of extending and developing computer support in the academic setting. What was only recently discussed as the "computer-intensive campus" or the "campus of the future" is already fast becoming the norm for all schools. Even where large expenditures are not possible, there are many networking advances that can be achieved at far more modest costs.

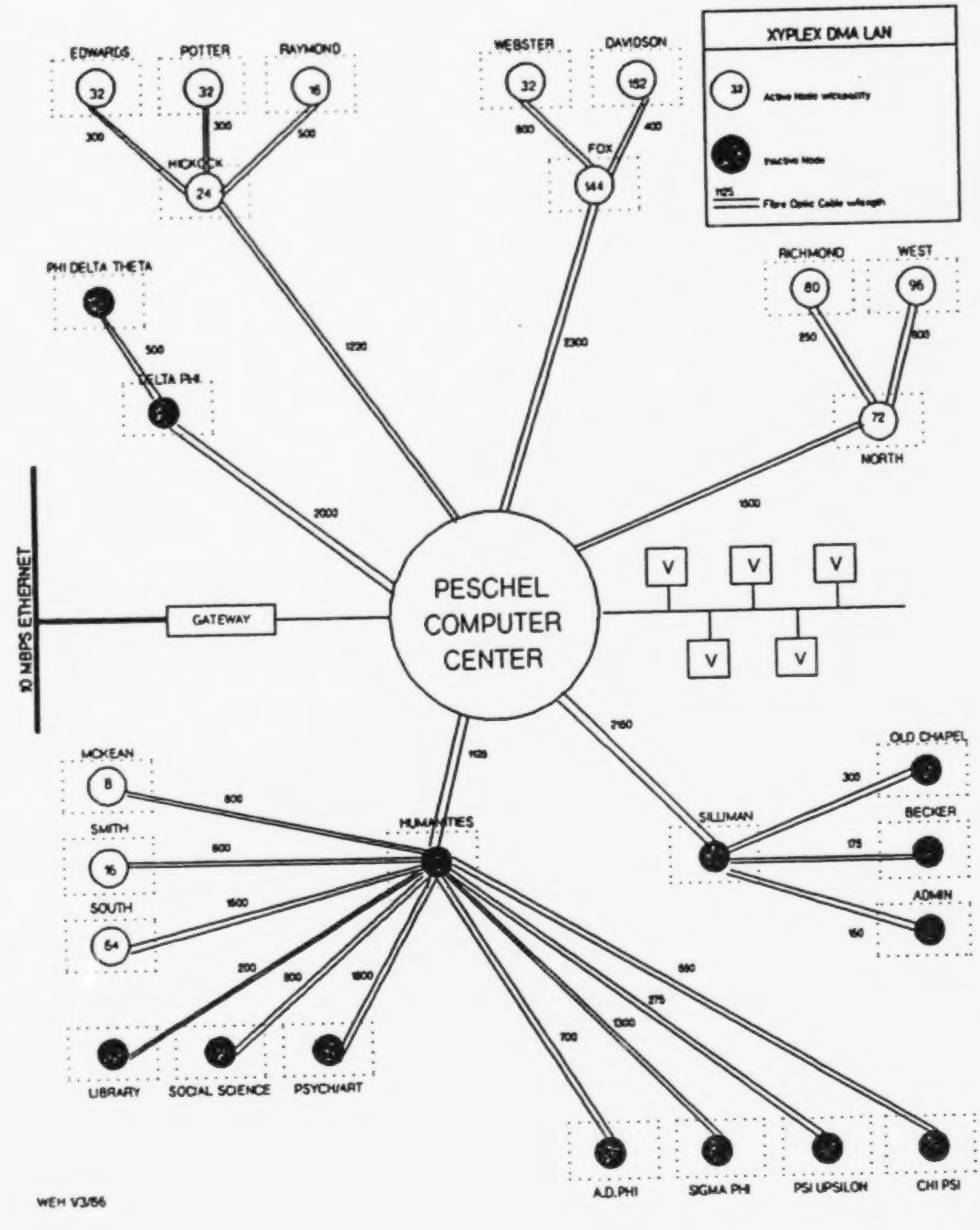
IEEE802.3 ACCESS: THE ETHERNET


BUTTERFIELD
BAILEY
Fibre Optic Cable
Xyplex DMA LAN
THE ETHERNET
WEH 1/6/86
VAX/750 TARDIS
PBX
CDR System
HP3000/48 GRIZZLY
Gateway
STEINMETZ
VAX/780 GENESIS
VAX/750 ALVIN
HP3000/68 GEMINI
VAX/785 GARFIELD
VAX/785 SIMON
VAX/785 THEODORE
ENGINEERING COMPLEX
M.E. Graphics CAD Lab
Repeater
M.E. Labs
10 mbps Ethernet BACKBONE

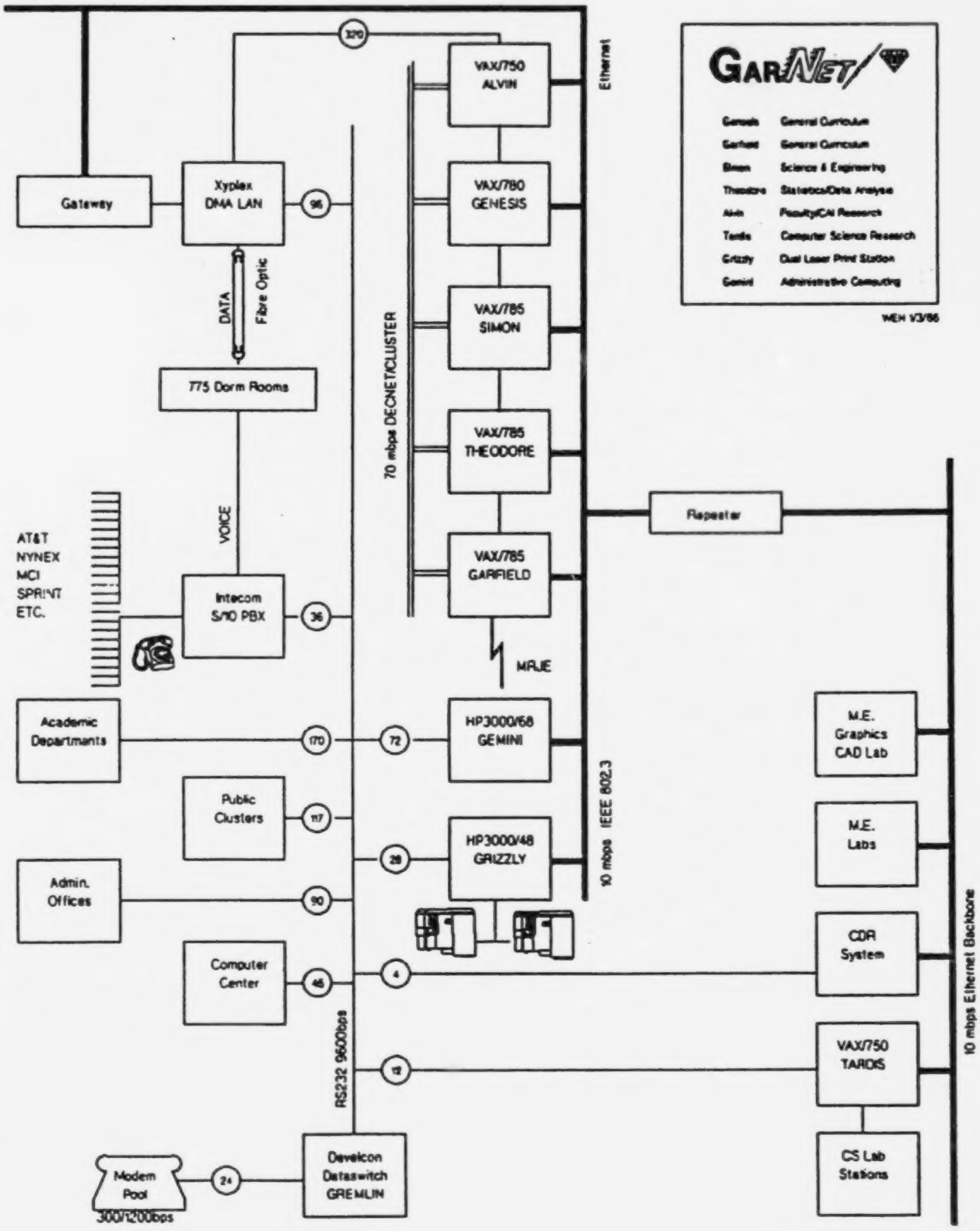
RS-232-C ACCESS: THE DATASWITCH NETWORK


9600 bps
200
4
72
28
96
1
CDR SYSTEM
1
HP3000/ 68 GEMINI
HP3000/ 48 GRIZZLY
DEVELCON DATASWITCH GREMLIN
300/1200 bps
4
NETWORKS
20
DIAL IN/OUT
XYPLEX DMA LAN
458
36
IBX S/10 PBX
320
775
VAX CLUSTER
DORMITORY
36
Remote Data
V
V
V
V
V
422
10 mbps IEEE802.3
Ethernet
13
LIBRARY CLUSTER
65
STEINMENTZ CLUSTER
28
CHUC
11
GCS CLUSTER
22
SOCIAL SCIENCES
4
PSYCHOLOGY & ARTS
80
ENGINEERING COMPLEX
20
HUMANITIES BUILDING
12
CS LAB
12
BAILEY HALL
5
FIELD HOUSE
15
BUTTERFIELD HALL
9600 bps
21
ADMIN. BUILDING
9
SILLIMAN HALL
8
BECKER HALL
12
WELLS HOUSE
20
LAMONT HOUSE
2
CAREER CENTER
11
SCHAFFER LIBRARY
2
OLD CHAPEL
1
PHYSICAL PLANT
45
COMPUTER CENTER
1
SECURITY
3
WHITIKER HOUSE
RS-232 NETWORK

DORMITORY ACCESS: VAX DMA LAN


XYPLEX DMA LAN
32 Active Node w/capacity
Inactive Node
1125 Fibre Optic Cable w/length
EDWARDS
32
POTTER
32
RAYMOND
16
300
300
500
HICKOCK
24
WEBSTER
32
DAVIDSON
152
800
400
FOX
144
RICHMOND
80
WEST
96
250
800
NORTH
72
PHI DELTA THETA
500
DELTA PHI
1220
2300
2000
1500
10 MBPS ETHERNET
GATEWAY
PESCHEL COMPUTER CENTER
V
V
V
V
V
2150
1125
MCKEAN
8
SMITH
16
SOUTH
64
800
600
1500
HUMANITIES
SILLIMAN
OLD CHAPEL
300
BECKER
175
ADMIN
150
200
800
1800
550
275
1300
700
LIBRARY
SOCIAL SCIENCE
PSYCH/ART
A.D.PHI
SIGMA PHI
PSI UPSILON
CHI PSI
WEH V3/86

THE NETWORK TOPOLOGY


Gateway
Xyplex
DMA LAN
320
96
DATA
Fibre Optic
775 Dorm Rooms
VOICE
AT&T
NYNEX
MCI
SPRINT
ETC.
Intecom
S/10 PBX
36
Academic Departments
170
72
Public Clusters
117
Admin. Offices
90
Computer Center
45
4
12
RS232 9600bps
Modem Pool
300/1200bps
24
Develcon
Dataswitch
GREMLIN
70 mbps DECNET/CLUSTER
VAX/750
ALVIN
VAX/780
GENESIS
VAX/785
SIMON
VAX/785
THEODORE
VAX/785
GARFIELD
MRJE
HP3000/68
GEMINI
HP3000/48
GRIZZLY
28
Ethernet
10 mbps IEEE 802.3
Repeater
10 mbps Ethernet Backbone
M.E.
Graphics
CAD Lab
M.E.
Labs
CDR
System
VAX/750
TARDIS
CS Lab
Stations
GarNet/
Genesis General Curriculum
Garfield General Curriculum
Simon Science & Engineering
Theodore Statistics/Data Analysis
Alvin Faculty/CAI Research
Tardis Computer Science Research
Grizzly Dual Laser Print Station
Gemini Administrative Computing
WEH 1/3/86

NETWORK INTEGRATION AT CSULB

Stephen W. Kelley

Assistant Vice President
Information Technology Services
California State University, Long Beach

Abstract

The converging technologies of voice, data, video and computing hold the possibility of significant benefits through their synergy. However, the benefits of this integrative technology are unlikely to occur without first addressing the integrated management of this technology. This presentation describes the organizational issues that lead to integrating the responsibilities for voice, data, administrative computing, academic computing, and micro computer support into a single organizational unit at California State University, Long Beach (CSULB).

The presentation also describes the current state of the hardware integration of the CSULB digital voice/data PBX, its data switch and its X.25 network. The existing network connects terminals and micros emulating terminals to a variety of computing services for students, faculty and staff. Migration plans and the first implementation steps will be discussed towards a comprehensive network which will provide full connectivity for PCs in one LAN to other LANS and to mainframes. This plan features multi-vendor LANs chosen on the basis of price-performance, full functionality on day one, and the use of the existing X.25 network as the interim backbone. Migration to a higher speed backbone will occur as funds become available.

INTRODUCTION

Background

Converging technologies for the transmission and switching of voice and data make possible a management concept of an integrated campus communications utility that can provide superior services at lower cost than a fragmented collection of public utility and campus systems. Further, the technologies of communications are converging with the technologies of computing. These changes in technology and the changing needs of student, faculty and staff are presenting colleges and universities not only a great opportunity, but two challenges. The first is organizational, the second technical. Management must successfully respond to the organizational challenge of these technologies before the technical challenge can be taken up. This paper describes how California State University, Long Beach responded to both challenges.

California State University, Long Beach

California State University, Long Beach (CSULB) is part of the California State University (CSU) System, which is composed of nineteen campuses employing 30,000 faculty and staff to serve over 330,000 students. Campuses range in size from 3,000 students to over 30,000, with a thousand miles separating the southern and northern-most.

CSULB, the second largest University in the CSU, currently enrolls 33,586 students (23,961 FTES) and graduates over 4,700 students annually. More than 3,844 full and part-time faculty and staff provide both direct and indirect support for these students. The campus covers 322 acres and contains 78 buildings consisting of 2,882,955 square feet. The library contains 942,645 volumes.

The general mission of CSULB is to provide quality instruction through the Master's degree in the liberal arts and sciences, in fine arts, in applied fields, and in the professions. At present, CSULB offers 128 baccalaureate programs through 65 degrees and 70 master's programs through 54 degrees. The university emphasizes the essential functions of instruction, university and community service, and creative activity and research necessary for maintaining a quality instructional program. Research and creative activities are emphasized in many schools.

The communication process utilized to convey knowledge and provide services to students is continually enhanced by rapid changes in new technology. The integration of computer technology with communication technology is enabling CSULB to move from the computer era of the past to the information era of the future. CSULB is committed to distribute computer capabilities and tools which are tied together through communications to individual faculty members, staff, and students enabling individuals to realize their potential.

ORGANIZATIONAL INTEGRATION

Goals of Integration

The CSU has always been forced to seek the most cost effective way of providing services to ensure the quality of its programs are not sacraficed. This has been particularly true at CSULB. The University went through a procurement and installation of an Ericsson MD-110 voice/data PBX to improve telephone services and reduce costs. Once the cutover was made, the University decided organizational integration was necessary to reap the potential benefits of this new technology. It was felt that a fragmented organizational approach to managing high technology resources would significantly restrict the options available to the campus.

In making the organizational integration of computing and communications, several managerial benefits were anticipated:

- Improve service - one stop shopping for voice, data and computing needs.
- Improve planning - all future computing and communications purchases would fit into a cohesive plan to allow the network and computing to evolve incrementally as funding opportunities developed and to ensure compatibility.
- Cost avoidance - service could be improved by sharing overhead and better personnal utilization.
- Single point of contact - all trouble calls for telephone, terminal and micros would go through a single dispatcher, who would schedule appropriate personnel. This would insure consistency of response and uniform management tracking of responses.
- Increased flexibility - personnel would be cross trained so that calls to severral different people would not be required.
- Considered a prerequisite for technical integration.

Reorganization

In August 1985, CSULB consolidated responsibility for voice, data, administrative computing, academic computing and microcomputer support into a single organizational unit called Information Technology Services (ITS) (see Exhibit 1). This paper will focus primarily on the communications portion of the organization.

Communications and Office Services (COS) was created within Information Technology Services to support voice and data communications, terminal and microcomputer repair and the mailroom (see Exhibit 2). Its mission is to provide effective, reliable communications between people, between people and computers and between computers. Conceptually Communications and Office Services is responsible for all terminal equipment, be it a telephone, computer terminal or microcomputer, all switches and all cable. Responsibility for the traditional mail room allows the potential for intermixing paper and electronic mail.

Such organizational integration was not intended to preclude separate cable and switching systems for voice and data, rather, it facilitates the flexibility of using the most cost effective solution whether it be integrated or not.

INFORMATION TECHNOLOGY SERVICES

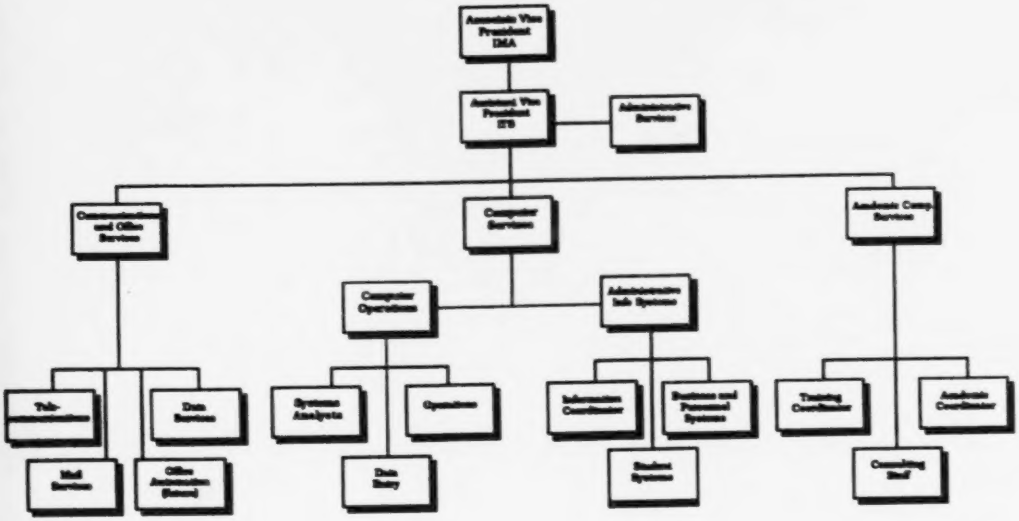
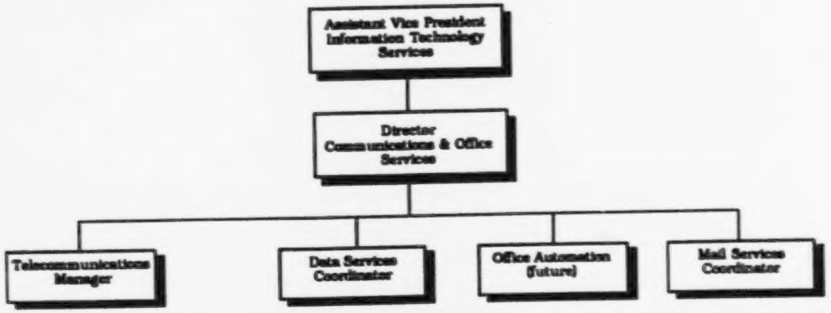

Associate Vice President IMA
Assistant Vice President ITS
Administrative Services
Communications and Office Services
Computer Services
Academic Comp. Services
Computer Operations
Administrative Info Systems
Tele-communications
Data Services
Mail Services
Office Automation (future)
Systems Analysts
Operations
Data Entry
Information Coordinator
Business and Personnel Systems
Student Systems
Training Coordinator
Academic Coordinator
Consulting Staff

Exhibit 1

Communications and Office Services

February, 1986


Assistant Vice President Information Technology Services
Director Communications & Office Services
Telecommunications Manager
Data Services Coordinator
Office Automation (future)
Mail Services Coordinator

- Digital switch operations
- Communications/ switchboard office
- Moves, adds, changes coordination
- Billing system management
- Telephone directory develop/distribute
- Telecommunications training program
- Inventory management & control

- Install, maintain, repair micros, terminals, printers, and other peripheral equipment
- Data network implementation & management
- Implement data switch integration
- Port selector management & upgrades

- Incoming mail distribution
- Outgoing mail processing
- Inter-campus mail distribution
- Mail accountability, system management

Exhibit 2

The Campus Information Resource Plan for 1986-1991, completed in May 1986, crystalized many of the communications plans discussed in the second half of this paper. It called for interconnecting all existing voice and data switches into a single network. Further it laid the foundation for a high speed campus wide backbone system to interconnect Local Area Networks of PCs as they developed.

Challenges

The reorganization took place a month after the July 1985 cutover of the 3200 line Ericsson MD110 voice/data PBX. Most of the effort prior to the reorganization was spent to ensure the successful switch cutover, with little attention paid to the demands of the ongoing operation of the new campus telephone company. When ITS took responsibility after the cutover, it was faced with the following problems:

- No suitable billing software for the new telephone system.
- A directive to expand chargeback from billing only non-general fund departments to billing all general fund departments as well.
- No written procedures for anything.
- A one year delay in delivery of data on the system
- Too few personnel to handle the greater complexities of running a telephone company.

All of the original plans for integrating voice and data were initially put on hold in the effort to keep our heads above the large number of moves, adds and changes (MAC's) after the cutover. Plans were further complicated by delays in hiring key personnel. But by February 1986 a programmer had been hired, a computer documentation specialist was helping with the MAC's and a telecommunication consultant had been hired to address the broader policy issues.

After a little more than a year, and despite serious resource limitations, COS has made major advances on all fronts:

- An integrated telephone and postage billing system that produces itemized bills, plus department, school, division and university summaries was developed.

- A full chargeback system which allows resources to be managed at the division, school or department level, at the choice of each division was developed. Transactions to the campus Financial Accounting System (FAS) are generated automatically by the billing system.

- Data is fully operational and fully integrated into the other campus switches. (More about this later)

- Procedures for many of the major processes have been written.

Integration After One Year

Significant progress has been made after only one year. Further improvements are needed but the University believes the structure is in place to accomplish all of the anticipated benefits. The current status is:

- Improved service - CSULB has gone from a limited rotary dial system to touchtone at every desk with advanced features to improve productivity. Although service has significantly improved, it can further be improved, particularly in the area of more prompt MACs.
- Improved planning - this has been achieved through the Campus Information Resource Plan.
- Cost avoidance - Cost savings of $60,000 were achieved in the first year.
- Single point of contact - to make this work effectively requires an integrated database. We have not been able to find any off-the-shelf software that runs on equipment we own or at a standalone system with a cost we can afford. An internal development project should be completed by July 1987.
- Increased flexibility - Our computer equipment technicians have become very skilled with the voice and data features of the PBX , as have our our administrative computing consultants.

The benefits of organizational integration are real and significant progress has been made. With over one year's experience CSULB still believes that organizational integration was the right approach to take.

NETWORK INTEGRATION

Current Network - Terminal to Mainframe Based

The ultimate goal of communications is to be able to communicate with any other device on the network. Standardization plays a key role in meeting this goal whether it be for voice or data communications.

CSULB has standardized computer workstations characteristics. For asynchronous terminals the VT100 was chosen, though some VT52 terminals remain. The synchronous terminal standard is the IBM 3270. The campus network currently only switches asynchronous terminals and IBM compatible micros and MacIntoshes emulating VT100 terminals. The Kermit VT100 communications package is used on student, faculty and staff micros and is placed on all mainframes/minis.

Over 500 of these workstations are currently connected to one of three switches that serve the CSULB students, faculty and staff. All were obtained prior to the organizational integration and for specific purposes.

- Gandalf PACX 1000 - Primarily to connect student terminals and micros emulating terminals to the campus mainframes. Speeds typically are 1.2kbps.
- Dynapac X.25 Switch - Originally used as the gateway for faculty and students into CSUNET, the X.25 network that links all nineteen campuses of the California State University system plus the UCSD Cray and other computers. The switch supports trunk speeds up to 56kbps, though 9.6 and 19.2kbps predominate.
- Ericsson MD110 - A 3200 port voice/data PBX serving faculty and staff. About 5% of the ports use data at 9.6kbps.

By June 1986 these three switches had been interconnected, so all resources are accessible by any terminal or micro connected to any of the switches (see Exhibit 3).

New Data Communications Environment

The communications environment at CSULB has changed over the last few years. The existing system was designed to connect terminals with limited intelligence to mainframes or minis, where the terminal user would share the computer's processor, files, printer and software. Speeds began at 300 to 1200bps, with desired speeds of 9.6kbps. The communications were terminal to host oriented. That is, a class of devices called terminals could connect to a class of devices called "ports" or "hosts". Terminals could not readily connect to other terminals and hosts could not readily connect to each other.

Over the last few years the data communications environment has changed. Now that micros are becoming the dominant workstation on campus, micros in one area want to connect to each other to share files and printers and to be able to share files and printers on micros across campus, as well as to be able to access all of the mainframe computers. To effectively transfer files between systems and to handle anticipated traffic volumes, speeds in the megabits per second range are required. A network of networks is needed to provide connectivity and far higher speeds between workstations than the 9.6kbps that the current system supports.

Planned Evolution of the Network

The new network strategy is based on PCs connected together in Local Area Networks that can share mainframe, mini and micro resources throughout the campus and off it. The existing X.25 network will form the backbone of this network until funding for

CSULB DATA COMMUNICATIONS

FY 1986/87

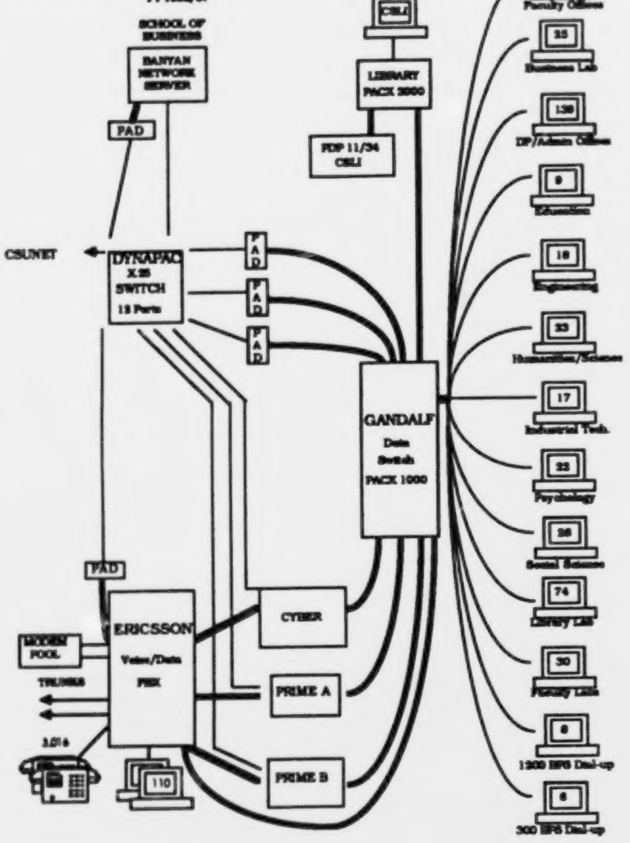

SCHOOL OF BUSINESS
BANYAN NETWORK SERVER
PAD
LIBRARY PACX 2000
CSLI
PDP 11/34 CSLI
CSUNET
DYNAPAC X.25 SWITCH 12 Ports
PAD
PAD
PAD
GANDALF Data Switch PACX 1000
14
Faculty Offices
25
Business Lab
130
DP/Admin Offices
9
Education
18
Engineering
33
Humanities/Science
17
Industrial Tech.
22
Psychology
28
Social Science
74
Library Lab
30
Faculty Labs
8
1200 BPS Dial-up
6
300 BPS Dial-up
PAD
ERICSSON Voice/Data PBX
MODEM POOL
TRUNKS
3,016
110
CYBER
PRIME A
PRIME B

Exhibit 3

INSTRUCTIONAL NETWORK PHASE I FY 86/87

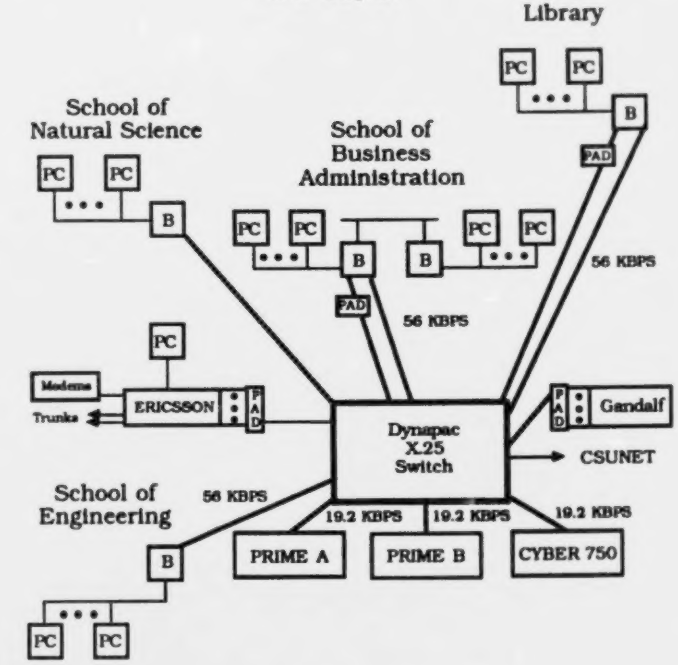

Library
PC
PC
B
PAD
School of Natural Science
PC
PC
B
School of Business Administration
PC
PC
B
PAD
B
PC
PC
56 KBPS
56 KBPS
PC
Modems
Trunks
ERICSSON
PAD
Dynapac X.25 Switch
PAD
Gandalf
CSUNET
School of Engineering
56 KBPS
B
PC
PC
19.2 KBPS
19.2 KBPS
19.2 KBPS
PRIME A
PRIME B
CYBER 750

Exhibit 4

the high-speed broadband network becomes available. The Ericsson PBX will be used by faulty and staff with terminals and stand alone micros. The Gandalf will be phased out as student terminals are phased out. Although the initial focus is on student micros, sufficient security exists to all administration LANS to attach to the same network.

The goal is several years away. However, a phase-in strategy maximizing current resources has allowed CSULB to begin an implementation where the full features of the final network are available initially, with higher speeds and additional connections as funding becomes available.

Much attention has been focussed on the lower levels of the network such as whether to use Ethernet, IBM token ring, Starlan or other network systems. While important, these decisions are best left to how much performance a LAN owner is willing to pay for. The overriding campus concern should be with the network operating system and the interconnection of LANs For example, even if all LANs use the same Ethernet card, if one campus LAN uses 3 COM's 3+, another Novell Advanced Netware and another Banyan's VINES, they will not be able to share disk, printer, communications resources, and campuswide applications such as mail, certainly not as transparently as desired.

While several satisfactory solutions may exist, CSULB has plans to standardize on Banyan's VINES network software, based primarily on equipment already installed in the School of Business as a result of a competitive bid. It features a strong integrated communications support in addition to its print and file server capabilities. It currently features:

* IBM NETBIOS compatibility
* VT-100 and IBM 3270 terminal emulation
* SNA and bisync communications interface up to 19.2kbps
* X.25 communications interface at up to 64kbps
* Support of Ethernet, IBM Token ring, ARCNET, Corvus Omninet
* Can interconnect broadband and baseband networks
* Remote async dial-in
* Async dial-out
* True file server
* Global resource naming and sharing across all LANs.
* Comprehensive security
* Extensive system and network management facilities

CSULB is in the middle of evaluating this arrangement and will decide soon whether to go forward in February 1987 with the initial connection of about 170 micros on six file servers at various locations on the campus (see Exhibit 4). These micros will have the full functionality of the final network, though some operations from a remote file server will take slightly longer than those on a local server due to the slow 56kbps server-to-server link. This slower speed will be eliminated when the broadband backbone is installed.

In the first phase of this new Instructional Network different LANs are connected through the existing X.25 switch at 56kbps (limited by switch). When a broadband backbone is installed in some future year, simply adding a broadband card will allow the LANs to communicate with each other at megabit speeds. Nothing needs to be thrown away. Everything that is purchased during the phase-in is usable on the final network.

The initial implementation of Banyan's X.25 implementation supports server-to-server functions only. However by using the async dial-in and dial-out capability plus an existing Packet Assembly-Disassembly (PAD) device, PCs on any LAN may use the terminal emulator and access any mini or mainframe on the X.25 network through menus.

The Ericsson MD110 and the Gandalf, which are already connected to the X.25 network, allow PCs connected to them to attach to the LAN and act logically as if they were locally attached to the LAN. The slow 9.6kbps link for the Ericsson and the even slower Gandalf link to the LAN makes some of the capabilities impractical, but does allow the sharing of files and access to mail.

Banyan VINES allows various levels of resource management. Communications and Office Systems will control the entire network, however schools will control their students and resources, and may delegate further down to the department level.

Data is not the only network component receiving planning attention. Service will be expanded to two new buildings planned for completion in 1988 and 1989. We plan to extend services to the on-campus student dorms in FY88/89 which will add about 2,000 phones to the system. We are seriously investigating serving the Chancellor's Office some seven miles away with about 600 phones through remote cabnets to our system. The first phase would provide service to the Chancellor's Office Office of Computing and Communications Resources (CCR) when they move into a new building in early 1987.

Such expansion of the voice and data system will have organizational impacts. We are investigating the possibility of establishing Communications as an Auxiliary Enterprise, which would significantly increase its flexibility in serving the diverse campus needs.

Conclusion

The organizational integration of communication technologies at CSULB has brought benefits and will continue to bring benefits as various infrastructure projects such as the Instructional Network and the integrated communications data base are completed. This integrated management has enabled a clear development plan for voice and data to be articulated in order to expand and improve services to faculty, staff and students.

Track V

Special Environments

All institutions are affected by the recent developments in information technologies; however, there are certain types of institutions (e.g., small colleges, community and other two-year colleges, multicampus/state systems, medical/health science centers, and independent institutions) that have unique concerns not shared by those outside their special environments. This track offered a forum for discussion of such interests.

Coordinator:
Vicki J. Candella
Cincinnati Technical College

Marion Ball
University of Maryland/
Baltimore

Linda Heidel
Stanford University

PLANNING AND IMPLEMENTING A MULTI-INSTITUTIONAL STATEWIDE STUDENT INFORMATION SYSTEM

Prepared by
Alan W. Hartwig
Administrative Systems Development Director
South Dakota Board of Regents
Pierre, South Dakota 57501
and
Leonard M. Brush
Director, Administrative Systems
Carnegie Mellon University
Pittsburgh, PA 15213

for

The 1986 CAUSE National Conference
December 9-12, 1986
Hyatt Regency, Monterey, California

ABSTRACT

The planning and coordination required to implement administrative systems within a single institution is significant. Such an effort across multiple institutions will succeed only if the members of each institution feel that "the whole is greater than the sum of the parts." This has been the case with the six public institutions of higher education in South Dakota. These institutions have planned, worked closely together and are now completing the implementation of a statewide student information system to serve the needs of six campuses and the Board of Regents. This paper discusses issues related to planning and implementing software for use and access by the six institutions and the Board.

INTRODUCTION

The South Dakota Board of Regents (BOR) is the governing board for South Dakota's six public institutions of higher education. In addition, the BOR governs two special schools for the handicapped, visually handicapped and deaf. The Board is authorized by the state Constitution and statutes. All Board members are appointed by the Governor normally for six year terms unless filling a vacated Board seat. The Board maintains an office in the State Capital, Pierre and is administered by an Executive Director and a staff of 15 professionals, including the Information Systems Director who reports to the Office of the Executive Director.

The six public institutions of higher education include two universities and four colleges which are administered by Presidents appointed by the Board. The two special schools are administered by Board-appointed Superintendents. In academic year 1985-86 the two universities and four colleges enrolled approximately 21,000 students and were supported by an annual budget (from all funding sources) of $175 to $180 million, a total work force of approximately 4300 full time equivalents and library holdings in excess of 1.3 million volumes.

Institutional Profiles

The University of South Dakota, Vermillion
USD was established by the Dakota Territorial Legislature in 1862 and began classes in 1882. It is located on the Missouri River in the southeastern part of the state near the Iowa and Nebraska lines.

South Dakota State University, Brookings
SDSU was established in 1881 by the Dakota Territorial Legislature as an agricultural college. It is the land grant university and the largest South Dakota institution serving approximately 7,000 students. SDSU is located in eastern South Dakota 20 miles from Minnesota.

South Dakota School of Mines and Technology, Rapid City
SDSM&T, located in western South Dakota has an enrollment of nearly 2,600 students, provides education, research and community service to the state. Established in 1885, it opened in 1887.

Northern State College, Aberdeen
NSC, located in northcentral South Dakota, 50 miles from North Dakota was established in 1901. 2,700 students are enrolled in the college which offers 46 majors emphasizing education in teacher training, business and liberal arts.

Black Hills State College, Spearfish
BHSC with nearly 2,400 students is located in the northern Black Hills 50 miles northwest of Rapid City and 5 miles from Wyoming. The territorial legislature established the institution in 1883.

Dakota State College, Madison
Founded in 1881, DSC is located 35 miles south and west of Brookings and 40 miles from Minnesota. Since 1984, all programs prepare graduates both in their specialities and the information processing and technology. Approximately 1,000 students are enrolled.

Objective

The implementation of comprehensive administrative information systems for all Board of Regents institutions was established as a major Board objective for FY1985 and FY1986. This objective required a planned implementation program; the first phase of which was the planning and implementation of a student information system. The student information system was to create an integrated data base of information related to the academic curriculum and performance of each student. The student system was to accommodate other student data related to marketing, recruiting, admissions, tuition and fee assessment, student billing, financial aid, housing assignments and biographic and demographic data capture. This paper addresses the manner in which the Board and the institutions planned for and implemented the SIS.

Existing Status of Student Information Systems

Each institution had developed their own administrative systems independently from the others. It is understandable then that the technology on which those systems were based was also different each campus to the others. Table 1 summarizes the status of student information systems at each campus in 1984 and shows that the environment was predominantly batch oriented. Further the systems in place reflected a second generation design approach. This status provided the rationale for selection of the SIS as the first phase of the implementation program.

1984 Status of Student Information Modules
at South Dakota BOR Institutions

Institution	Admissions	Registration	Financial Aid	Records	Billing and Receivables
A	I/O	I/O	O	B	I/O
B	O	O	B	O	B
C	O	B	B	B	B
D	B	B	B	B	B
E	B	O	B	B	B
F	B	B	B	B	B

I = INTEGRATED, O = ON-LINE, B = BATCH

Table 1

PLANNING FOR CHANGE

Vision

Normally the planning activity is oriented toward what procedural steps need to be taken, when and in what order. Planning, to be effective, should be based on a clear vision, a well articulated strategic purpose and a consensus of the critical constituents or beneficiaries. The vision for a computing system may be simply stated as in the case of Virginia Tech's "An Information Systems Strategy" dated November 23, 1985. The VT vision (as stated) is of a "single system image"; their strategic planning for computing and information systems necessarily then follows that vision. The guiding vision for South Dakota computing and information systems in 1984 was less ambitious (than Virginia Tech). **The vision was** to promote centers of academic excellence through increased access to computing resources and **to meld the goals for administration and management of the six Board of Regents Institutions with the goals of the BOR**. John Naisbett in his best seller MEGATRENDS said "strategic planning is not enough; it becomes planning for its own sake." Strategic planning is worthless -- unless there is first a strategic vision."

Strategy

Selection of a Project

The strategy for achievement of the vision was to first select a project of joint mutual and individual need which would be in the path of the vision. The student information system (SIS) was determined to be such a project for these reasons:

- Common systems implementation among the six institutions would encourage interinstitutional communcation and cooperation.
- An interinstitutional project would give the BOR the opportunity to influence the outcome and ensure that regental requirements would be addressed.
- The system set the stage to take advantage of economies of scale should those economies result.
- The SIS because of its potential impact on students and faculty not only was (thought to be) a step toward achievement of the vision but also provided the opportunity to gain the support of the academic constituents.

Understanding the Environment

Strategy at the same time required an understanding of the political, economic, governance and academic environment within which change was to be integrated. Such questions as: **Who are the political forces in the environment? Who can say "yes" and who can't say "yes" but can only say "no"? Is there a clear cut, agreed upon need for change?** --- must be asked and answered.

For South Dakota these specific questions were important to be answered:

- Should the computing systems environment be enhanced?
- To what extent should computing resources on campuses be enhanced?
- Which existing resources should be used as a starting point for enhancement?
- Can higher education proceed to enhance academic and administrative computing simultaneously?
- Should planning occur simultaneously for microcomputers, mainframes, communications, departmental computing, student computing and faculty computing?
- To what extent should centralized computing be fostered and enhanced when distributed and departmental computing was emerging as a clearly viable option to meet many needs?
- With the changing technology and a dearth of qualified information technologists in South Dakota, for how many years could the vision extend?
- How much enhancement can be operationally sustained or financially supported?

Seeking Sanction

Strategy included seeking sanction. Supporters granted their permission; adversaries withheld their permission. The supporters included a coalition of the Board, the Presidents and the Governor who each supported change. The direction and details of the change was a matter of debate and discussion, but productive change as a shared vision achieved early consensus. There were some adversaries to the state wide common system who felt the technology was pointing toward more distribution of computing resources rather than more centralization. It is clear that this view was and is meritorious. Sufficient financial resources were not available to achieve six separate solutions to the administrative information system requirements. The most achievable solution seemed to be through a common system. The strategy for academic computing was, however, to embrace distribution of computing resources.

Selling the Change

Strategy required selling both the need for and the direction of change. Given the depletion of resources in support of administrative and academic computing in 1984, the need to enhance the resources seemed obvious. Selling a state-wide system required presentation and explanation to a much broader base of clients than for single institution solution. Rather than solicitation of support from one President at one institution, six Presidents needed to be convinced.

The Board of Regents, the State Legislature and the Governor's Office were key participants. The Board had to be convinced that implementation of a student information system would contribute to the vision they had for higher education and computing. Not all Board members were equally convinced; some were opposed. Because the State legislature was asked to (partially) support the plan with tax dollars they were particularly skeptical. The Governor's Office was the critical linchpin to the successful "sale". The Governor had led the State in an effort to place resources for enhancement of computing and information systems throughout all state agencies. In particular the framework for an information technology campus at Madison was established. The SIS was viewed as a logical extension of those efforts. Without the Governor's support, the SIS would not have moved forward.

Cost/Benefit

To achieve their objectives the Board recognized the need to commit substantial funds from a variety of sources so as to invest adequately in support of their vision. Before the implementation would begin the Board required an explanation of the projected benefits as well as costs.

Benefits Criteria

The primary criteria for investment in the installation, implementation and operation of a student information system were:

- enhance accountability for expenditure of student tuition and fees, state appropriations, and federal funds.
- create an information resource to provide the Presidents and the Board of Regents with timely information about degree programs, academic disciplines and supply and demand for courses and programs.
- provide more timely and consistent information to the Legislature and the South Dakota Bureau of Finance and Management.
- enhance the academic advising and academic career planning for all students.
- support more effective recruiting, admissions and retention of students for all institutions.
- eliminate or substantially reduce the current maintenance burden associated with existing computer programs.
- reduce and/or eliminate redundant entry of common data into the institutions' data bases.
- provide information to enable the institutions to manage more effectively and efficiently.

Anticipated Cost/Benefits

The anticipated benefits of the new student information system were defined as either tangible or intangible. Tangible benefits were believed to have financial impact; intangible benefits were defined by improvements in service, management or operations.

Tangible Benefits

The opportunities for tangible benefits to be delivered from the new student information system were stated as follows:

Opportunities for Revenue Enhancement

- The implementation of a full function batch and on-line registration system coupled with a tuition and fees calculation and assessment module would provide the opportunity to collect tuition and fees approximately one month earlier than presently done.
- The cost of administrative computer systems (hardware and software) are legitimate ingredients in cost recovery rates for Federal contracts for research, public service and instruction.

Opportunities for Cost Reduction

The opportunities for cost reduction associated with the implementation of the SIS were expected to be:

- The creation of a new set of applications software operating in a data base management environment which would eliminate the need to continue maintenance on the collection of existing (computer) applications programs performing the same or similar functions at six institutions.
- The requirements for the SIS call for Federally mandated changes to financial aid software to be provided by the software vendor; the cost of maintaining those changes (currently done by each institution) could be avoided.

Intangible Benefits

Intangible benefits projected for the new student information system are:

- Enhanced academic advising for students through more complete information readily available to their advisors.

- Enhanced selection of courses for any given registration through the opportunity for both the student and the advisor to work together interactively and on-line toward a feasible student schedule of courses.

The anticipated benefits provided the opportunity for savings or change; however, policy decisions or changes in procedures still are required to capitalize on the opportunity.

PLANNING

Assumptions

In order to proceed from vision toward accomplishment of the reality, many of the strategy questions were answered. These answers then formed the planning assumptions for the SIS project:

- The academic computing resources would be enhanced in concert with the SIS implementation.
- The campus computing resources would be enhanced adequately to progress on an orderly path toward implementation of the strategic vision.
- Existing mainframe computing in support of administrative information needs would be the starting point for enhancement. Specifically this meant upgrading the existing IBM 3031-AP at the USD to a 4381 Model Group 2 and consolidating all major administrative information applications on the single machine using ADABAS as the data base management system.
- Planning for all levels of institutional computing would proceed in concert.
- Implementation for all institutional computing would be the joint responsibility of the institutions and the BOR, specifically the Information Systems Coordinator.
- System-wide centralization of administrative computing would be promoted during the first 5 years (1985-1990) of the plan; computing in support of academic needs would be implemented in a distributed fashion first by campus, then by department and individual. Multiple vendors would be actively recruited for support of academic computing.
- The plan was to have two primary time horizons: 5 year implementation planning for administrative computing and a 2 year planning for academic computing.
- New funding sources and cost savings would have to be identified if the vision was to be met; the dearth of discretionary funds in the institutional budgets made it clear that they alone could not carry or sustain the burden of all the enhancement to the computing systems environment

Planning Ingredients

A significant part of planning is to identify those ingredients which can contribute to success or conversely can promote failure. For the statewide student information system these ingredients were relevant and, we believe, proved significant to the success of the effort:

- Establish new or use existing communication channels among the institutions.
- Identify key institutional personnel who can make the project a success; get their commitment.
- Select a "star" within the system to facilitate the planning and direct the implementation.
- Insist that the institutions write a set of functional requirements whether or not a request for proposal (RFP) will be used.
- Review your requirements in many forums (campuses, vendors, other systems or institutions).
- Develop a timetable for all steps of the process; visualize the completion.
- Determine project costs and revenue streams.
- Make sure the advocates are informed, the adversaries are involved, the decision-makers and funders are interested and the facilitators are in the wings.

Putting The Plan Together

Organization

The organization of the SIS planning process created a central coordinating role at the BOR office to ensure implementation of the vision while at the same time vesting the responsibility and authority for the specifications, oversight and management jointly with the institutions and the BOR office.

To implement a new statewide student information system it was necessary to establish an organizational framework. This framework included bringing together both advocates and adversaries. Further the participants were selected on the basis of their intimate knowledge of the various functions to be incorporated within the SIS. Three Financial Aid Directors, Admissions Deans, a Registrar, a Computer Center Director and a M.I.S. Director served on the SIS Planning Task Force. A President, two Business Managers, one Student Services Director, one Computer Center Director, one Director of Learning Resources and the Information Systems Coordinator served on the Student Information System (Executive) Steering Committee. The organization established to plan for the SIS implementation is shown in Figure 1.

The extent and cooperation of the campus participants cannot be overstated. As one task force member stated early in the process, "the task force seems to have done a tremendous job in coming together in an area that has seen nearly a century of independent effort." A century may overstate the point but the spirit of cooperation was evident even to the task force members themselves.

Organization for SIS Planning

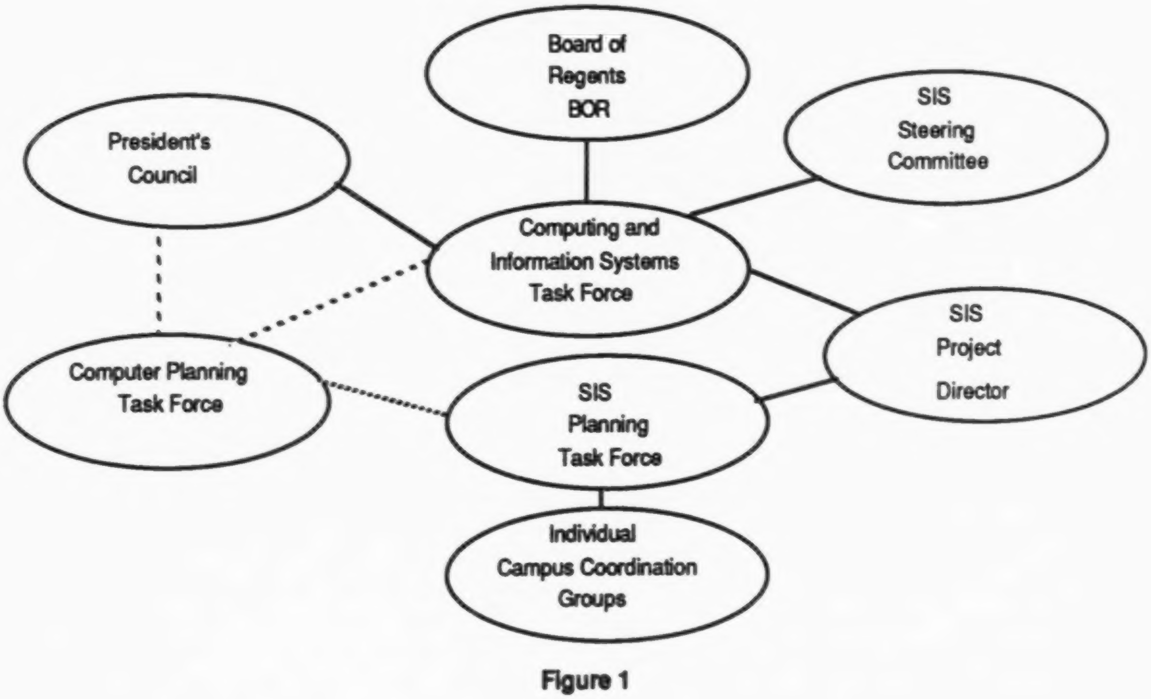

Board of Regents BOR
SIS Steering Committee
President's Council
Computing and Information Systems Task Force
SIS Project Director
Computer Planning Task Force
SIS Planning Task Force
Individual Campus Coordination Groups

Figure 1

Schedule

Planning for the implementation of a system of this scope requires a plan that is flexible.

Plan A

The initial plan was to: (1) develop the functional requirements, (2) review the requirements both internally and externally, (3) use the requirements as the core for a request-for-proposal (RFP), (4) transmit the RFP to appropriate vendors and develop evaluation criteria, (5) receive and evaluate proposals, (6) select the best combination or single vendor to meet the requirements, (7) negotiate a contract and (8) proceed to implementation. This approach seemed quite conventional and had been tried with varying degrees of success by others. Table 2 shows the timeline for Plan A.

During the first three months of the planning effort, the task force decided that a more intimate knowledge of what was available in the "marketplace" would be helpful and desirable. Toward that end five vendors were contacted and subsequently provided on-site presentation and in some cases demonstrations of their systems. The conclusion of the task force was that only two of the vendors would be able to meet the needs of the six institutions.

A second factor impinged on the original plan (A). Through discussions with the BOR Legal Counsel and the State Attorney Generals office it was revealed that South Dakota law does not require competitive bids for computer software purchases. This knowledge coupled with the unanimous conclusion of the task force that only two of the five vendors would or could adequately respond caused the task force to abandon the RFP steps in Plan A. **Plan A gave way to Plan B.**

Plan B

The revised plan eliminated the need for a formal RFP proposal effort by the two vendors and the subsequent evaluation. In addition to expediting the planning timeline, elimination of these three steps also resulted in reduced expense to both the vendor and to South Dakota. The revised plan was to: (1) use the requirements document to conduct in depth evaluation of each vendor's product, (2) require that each vendor review the South Dakota requirements, (3) subject to inclusion in any future contract, identify those requirements which would be met by the vendors software, (4) determine the extent of modifications to software necesary in each case, (5) gain access to vendor's baseline software for testing against requirements, (6) select the better fit to requirements from the two vendors, (7) proceed to negotiation of software contract with the "better" of the two vendors and (8) proceed to implementation. Table 2 shows the timeline for Plan B also.

During the next few months the task force began to realize that the ultimate expense of the modifications to the "baseline" or "vanilla" software would exceed the expense of the baseline software by a factor of 1.5 to 2.5. This realization along with the realization that the precise functionality and features of the baseline software in either case were not satisfactorily discernible from the hands-on experience caused the plan to change again. **Plan B gave way to Plan C.**

Plan C

Because of the uncertainity the task force plan changed to allow time for more in depth review of the two vendors and their products. The plan (C) as revised included: (1) intensive review with currrent clients of both vendors, (2) reevaluation of functional requirements, particularly as those requirements dictated significant modifications, (3) establishment of contractual modification specifications, (4) selection of the more likely to-be-successful implementation partner from the two vendors, (5) negotiate contractual terms, (6) notify the other vendor of intent to negotiate, (7) if negotiation is mutually agreeable sign a contract, otherwise, (8) begin negotiations with other vendor. Plan C likewise is shown in Table 2.

The SIS Task Force selected and recommended the purchase of the Integrated Student Information System (ISIS-3) from SCT Corporation of Malvern, Pa along with the Student Aid Management System (SAMS) and the Loan Application Processing System (LAPS) from SIGMA Corporation through SCT. The S.D. Board of Regents approved contract negotiations with SCT at their April 1985 meeting. Contract negotiations between the BOR and SCT began immediately and were completed with a signed contract on August 31, 1985.

Expenditure and Funding Plan

In order to achieve both dimensions of the "vision" i.e. **creation of centers of academic excellence through increased access to computing resources and to meld the goals for administration and management**, a consolidated expenditure and revenue plan was developed concurrently for both academic and administrative computing.

During the "selling" of the vision to the participants in the change, the need to put together a cohesive, comprehensive funding plan became evident. Further it was evident that while the institutions supported the vision, none were in a position to divert substantial funds from existing academic, academic support or administrative programs to meet the funding requirements. New sources of funds would need to be identified. At the same time neither the Legislative nor the Executive branch were disposed to foot the entire bill but were very much interested in the improvement of the administration and management of the institutions through increased use of computing technology. In addition, rapidly increasing acquisitions of computing hardware and software by departments, colleges and institutions, proved that academic administrators, faculty and students were placing greater demands on existing computing resources and required substantially greater access to new resources.

An expenditure and funding plan, then, was derived using two basic assumptions: (a) the benefit to be derived from enhancing the computing resources would be felt directly by students, faculty, administration, and BOR and indirectly over the long term by state government and ultimately by the taxpayers; (b) the cost would be shared by all who would benefit. The expenditure plan identified an average of $1 million per year for 10 years in additional computing resources. These expenditures were to be made for both hardware and software to support implementation of three major administrative systems (SIS, Financial Information Systems and a Human Resource Information System) and replacement or upgrade of campus, departmental and instructional laboratory computing equipment. The expenditure plan requested for an immediate infusion of funds for much needed academic and administrative computing resources. The plan also recognized the need to continue to enhance the resources for years to come. The plan specifically identified the beneficiaries.

Since the increased expenditure of funds would have to be met with a corresponding increase in revenue, a revenue plan was developed. The revenue was planned to be derived from four souces:

(1) Cost savings and revenue enhancement from the new administrative systems. (26%)
(2) Increase in the student fees to be used near exclusively for academic computing. (45%)
(3) Increase in the state appropriation to be used primarily for investment in the administrative systems. (17%)
(4) Recycled institutional funds from other programs primarily into academic computing; since additional funds were being appropriated for administrative computing the campuses were able to concentrate recycled funds into their own academic needs. (12%)

The result of this proposed distribution was that over a 10 year period the institutions were expected to provide substantial savings to support the enhancement. If this does not happen, then, either the enhancement will slow down or student fees will increase to pick up the slack; it is also possible that the Governor would ask for additions to future years' budgets. Table 3 summarizes the 10 year expenditure and funding plan.

SUMMARY OF 10 YEAR FUNDING PLAN

Fiscal Year	Expenditure		Revenue		
	Administrative Systems	**Academic Computing**	**Student Fee ($1/cr.hr.)**	**Appropriation**	**Institutional Contribution**
1*	221,000	500,000	103,800	221,000	396,200
2	1,010,000	600,000	490,000	720,000	400,000
3	550,000	500,000	500,000	270,000	280,000
4	500,000	500,000	500,000	100,000	400,000
5	600,000	500,000	500,000	200,000	400,000
6	550,000	500,000	500,000	200,000	350,000
7	400,000	500,000	500,000	- - -	400,000
8	400,000	500,000	500,000	- - -	400,000
9	400,000	500,000	500,000	- - -	400,000
10	400,000	500,000	500,000	- - -	400,000

*FY85 (July 1, 1984 to June 30, 1985)

Table 3

IMPLEMENTATION

Organization and Management

The implementation for the Student Information System is managed through the Board of Regents' Central Office. The Administrative Systems Development Director (ASDD) is the project manager. The Higher Education Computer System applications programming staff reports to the ASDD.
The ASDD reports to the Regents' Information Systems Director.

Policy and budget issues related to the project are referred to the Administrative Information Systems (AIS) Steering Committee for recommendations. Recommendations from the AIS Steering Committee are forwarded to the Information Systems Director or the Council of Presidents. The AIS Steering Committee is composed of one representative from each of the institutions plus the ASDD. The institutional representatives are senior staff members at each of the institutions. The AIS Steering Committee started out as a SIS Steering Committee. The charge of the committee was changed in October 1986 to include all central administrative systems. This includes a central payroll/personnel system and a future financial information system. The committee's title was changed at the same time. The AIS Steering Committee meets approximately once a month.

An implementation team comprised of the institutional implementation coordinators makes recommendations to the ASDD or AIS Steering Committee on issues related to the implementation. The implementation team is involved in training, table building, testing, and specifying possible modifications to the software. A campus implementation team exists at each institution to plan and direct the implementation effort at the institution. The format and makeup of the campus teams varies from institution to institution.

This organizational structure as shown in Figure 2 has resulted in the involvement of a large number of participants from the institutions. Three of the six institutions have had their implementation team leaders leave the institutions during the project. The impact of these turnovers has been minimized by the large involvement on the campuses. The major change resulting from the turnover is a change in the complexion of the implementation team from a user oriented group to a data processing oriented group.

SIS PROJECT ORGANIZATION CHART

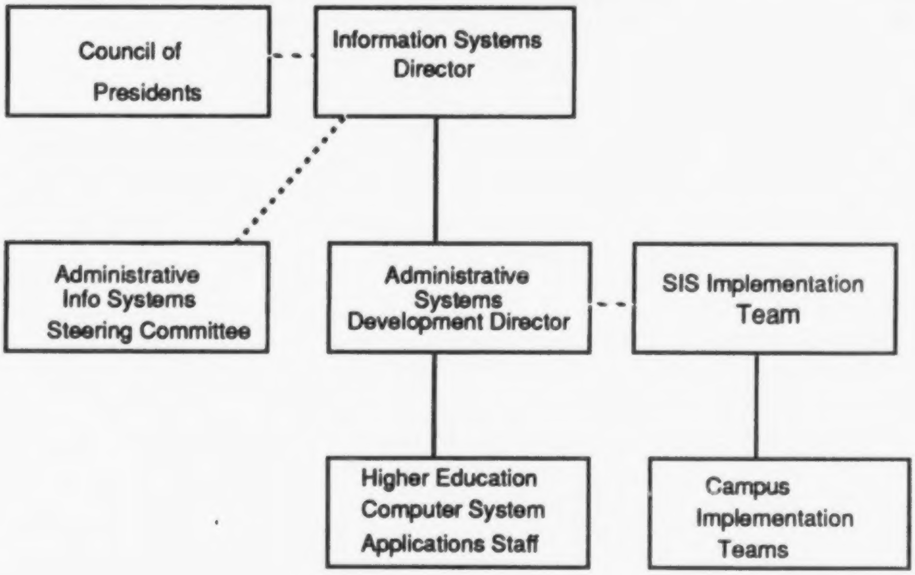

Council of Presidents
Information Systems Director
Administrative Info Systems Steering Committee
Administrative Systems Development Director
SIS Implementation Team
Higher Education Computer System Applications Staff
Campus Implementation Teams

Figure 2

The SCT organization is headed by a Regional Manager. The Regional Manager works with the ASDD and ISD on policy and contract issues between South Dakota and SCT. The SCT Project Manager works with the ASDD on training, testing, implementation, and technical issues. The SCT technical project leader works with Higher Education Computer System staff on technical and program related items.

Schedule

The project schedule at the time of the contract signing called for a dual path implementation. The Student Aid Management System (SAM) was to be implemented on a stand alone basis for the first year and then intergrated with the Integrated Student Information System (ISIS) . South Dakota did not contract for any modifications to the SAM System. At the same time, the ISIS implemention was to occur concurrently with the SAMS stand alone implementation.

The SAM system was scheduled to be in production by February 1, 1986. The first registration with the ISIS system was scheduled for November, 1986 at three of the six institutions. The other three institutions were scheduled for early registration by April, 1987. The System was scheduled for full implementation by June, 1987.

The SAM implementation system was put into production in August, 1986. The conversion of the SAM system from the CICS teleprocessing monitor to the Com-plete teleprocessing monitor was much more difficult than had been estimated. This conversion was the primary reason for the delay in the implementation.

The current schedule for ISIS implementation calls for early registration at all six institutions in April, 1987. The system is still scheduled to be in full production by June of l987. Turnover and change among the SCT staff caused delays in the production of the detailed specifications.

The original schedule called for installation of a baseline in March, 1986 which would have included the Multiple Institution Facility (MIF) and the integration of the SAM system. The baseline which was installed in June, 1986 did not include the MIF modification or the SAM integration. The MIF modification is being done at the same time as the South Dakota specific modifications. The SAM integration is scheduled to be completed by April, l987. Figure 3 and 4 show the original and the current implementation schedules, respectively.

ORIGINAL PROJECT SCHEDULE

Specify changes to baseline software	09/01/85 - 12/31/85
Approved detailed specifications for modifications	03/15/86
SAM system available in production	02/01/86
Install ISIS-3/ADABAS baseline	03/01/86
Modifications to baseline	04/01/86 - 12/31/86
Early registration at 3 institutions (DSC, USD, SDSU)	11/01/86 - 12/15/86
Early registration at remaining institutions (NSC, BHSC, SDSM&T)	04/01/87 - 05/15/87
Full implementation	06/01/87

Figure 3

CURRENT PROJECT SCHEDULE

Specify changes to baseline software	09/01/85 - 12/31/85
Approve detailed specifications for modifications	05/01/86
SAM system available for production	08/01/86
Install ISIS-3/ADABAS baseline	06/01/86
Modifications to baseline	06/01/86 - 04/01/87
Early registration at all institutions	04/01/87 - 05/15/87
Full implementation	06/01/87

Figure 4

Implementation Issues

The specification for modifications began prior to the contract being signed. A series of meetings was held between SCT consultants and South Dakota staff members to compare the requirements document against the SCT baseline software. The meetings were based on modules of the ISIS system. There were meetings for admissions, registration and records, financial aid, and accounts receivable. Staff members from each insititution attended the sessions. Every item in the requirements document was compared to the functionality of the baseline software. The baseline software met many of the requirements. Other requirements were deleted after discussions on the alternatives available with the baseline software. Some of the requirements were deleted by South Dakota as unrealistic, at least in a financial sense. The participants needed to understand the functionality of the baseline software, their own needs, and the needs of the other five institutions. The result of these meetings was a document referred to as the macro-specifications.

SCT prepared an estimate of the effort necessary to perform the modifications specified in the macro-specifications document. The original SCT estimate was at least twice as much as had been budgeted for modifications. South Dakota and SCT worked together to reduce this estimate by fifty percent. South Dakota withdrew the requests for several modifications and SCT revised estimates for modifications based on more detailed understandings of the modifications. The resulting document became part of the contract between SCT and South Dakota.

The macro-specifications needed to be turned into detailed specifications so that SCT could modify the baseline software. The process used to create the macro-specifications was used once again to create the detailed specifications. A series of meetings was held, again by functional unit, to define the specifications. The production of the detailed specifications resulted in a system specification for a single system to meet the needs of all six institutions. This process required a great deal of effort, sharing, and compromise by all participants. The needs of all six institutions had to be addressed and included even if the modification was only needed by one institution. In some cases more than one meeting was necessary to complete that section of the specifications.

SCT sent a draft of the detailed specifications to South Dakota for review on March 3, 1986. Each institution reviewed the document for 30 days on their own campus. A meeting was held between SCT and South Dakota insititutional representatives in April to review the specifications. The specifications, with a couple of exceptions, were given final approval in May.

The SCT software needed to be modified to accommodate six institutions using the same software and files. This modification is referred to as the Multiple Institution Facility (MIF). All records in the system have an institutional identifier as part of the record and as part of the key to that record. There is no shared data between institutions except for some system tables. All batch programs have the institution code as a parameter. The online system security was modified to include the institution code in the security scheme. All users of the system are assigned to an institution and may only access records with that institution code.

A great deal of discussion was held concerning the design of the MIF. The sharing of some basic biographic and demographic information was discussed but discarded in the final decision. Due to several extension programs it is not unusual for a student to be attending more than one of the institutions during a given term. This presented some serious potential problems for the data sharing concept.

The ISIS and SAM systems will be integrated in early 1987. In reality there will be some integration and some interfaces between the two systems. The integration will be mostly in the area of biographic and demographic information. The interfaces will be predominately between the ISIS accounts receivable module and the SAM disbursement module. The specification for the intergration was prepared by SCT and Sigma and reviewed and modified by South Dakota staff. Again all six institutions were involved in the review process.

The implementation is being done in a modular fashion. The order of the modules has been a topic of a great deal of discussion. The cycle for financial aid is different from the cycle for admissions which is different from the cycle for registration and billing activities. The implementation approach and order has been determined to a degree by the goal of early registration as the first visible ISIS event. Thus, catalog and schedule was the first module delivered. Admissions and general student data was the second module. Registration and fee assessment will be the third module delivered, accounts receivable will be the fourth module delivered and academic history will be the final module. The financial aid integration will be delivered during the registration and accounts receivable deliveries. This approach has resulted in the admissions module being implemented in the middle of the cycle. This will cause some extra work in the conversion process. The financial aid integration should occur at the beginning of a new financial aid processing year minimizing the impact of the conversion effort.

The training for the systems is being done using a "train the trainer" approach. A training session is presented by SCT to a group composed of one to three people from each institution. One of the institutional participants is usually the implementation team member. The other participants are from the functional areas affected. These participants then return to their institutions and train the other campus users. The Higher Education Computer System has a User Liaison/Training Coordinator on staff. This person coordinates the SCT supplied training and assists the institutions in their campus training.

LESSONS LEARNED

Contract Issues

There have been a variety of contract issues which have arisen during the project. The contract between South Dakota and SCT should have been more detailed in several areas. A more specific contract would have been to the benefit of both SCT and South Dakota. Contract generalities and understandings become even more difficult when turnover occurs on either staff. There has been a change in the SCT regional manager and the Information Systems Director in South Dakota since the contract was signed.

The Board of Regents required that the contract include a performance bond. The contract should also have included penalty clauses based on certain key deadlines in the schedule. The performance bond is really useable only in the case of ultimate failure and inability to resolve outstanding issues. Penalty clauses may have helped keep the project on the original schedule.

Baseline Software Issues

The baseline software for ISIS-3 under the ADABAS database management system was under development during the specification process. This lack of a formal baseline often proved to be a problem during the specification process. Specifications were sometimes based upon assumptions that were not correct once the baseline was complete and those specifications had to be modified. This caused a fair amount of confusion regarding the implementation.

The opportunity to install and work with the baseline software before specifying modifications would have been beneficial. The use of the baseline software would have presented alternative ways of achieving the required functionality. The number and significance of the modifications may have been reduced. Experience with the baseline would also have made implementation of the production system easier. Users would have gained an understanding of the relationships between modules and the system tables. There are many complex relationships among the data elements and the system tables. The ISIS-3 baseline utilizing the ADABAS data base management system was not available to use during the time of the specification effort.

Other Lessons

The functional units which had worked together in the past had a much easier time during the specification process. These groups already had a good understanding of the needs of the other institutions. The areas which had had minimum communications among institutions needed time to develop an understanding of the needs of the other institutions before they could specify the needed system functionality. A key to future success is continued communications between the users of the system at the various insitutions.

The institutional representatives have worked very hard on the implementation. The ability to understand needs beyond their immediate office and institution has been crucial to the success achieved so far. The participants have been able to examine alternative solutions to the problems and to make the necessary compromises. The successes accomplished so far would not have been possible without a lot of hard work and dedication on the part of the South Dakota participants.

The BOR and the campus participants have developed a great understanding of the institutional and system wide information needs. The campus staff members have become better at articulating their needs and understanding the relationships between functional units. The participants have also gained a perspective of the independent information needs of the institutions and the Board of Regents. The by-products of cooperation, communication and understanding achieved by the campuses and their representatives may outweigh in the longer term the value and benefits of the system.

LIBRARY AUTOMATION AT A MULTI-CAMPUS COMMUNITY COLLEGE

Deirdre A. Farris
Systems and Computer Technology Corporation
Hillsborough Community College
Tampa, Florida

A new solution to the charge of automating libraries on a limited budget! Hillsborough Community College will present how they converged technologies to meet their automation objectives. The system utilizes a VAX 11/780, IBM-PC's and MS-DOS Software. Following a description of this system, a discussion of considerations, implications and suggested guidelines for library automation projects will be presented.

INTRODUCTION

Computers. As recently as ten years ago, people had to enroll in special programs at colleges or technical schools to obtain hands on training with computers. Now, in 1986, there is no escaping them! We use computers every day, barely taking notice; automated teller machines, grocery store check out counters, ordering dinner in your favorite restaurant, and even in designing your dream home. The children are addicted to video games and five-year olds are using computers in pre-school.

Have you ever stopped to think how much more free time you have now that your daily activities have become computerized? Although some argue that computers eliminate an individual's thought process, the opposite is actually more accurate. People that interact with computers today, actually have more time to spend working towards achieving their goals.

Computers have been migrating into libraries across the country for the last five years or more. Why? Is it just to keep up with the trends? Is it fulfilling a software vendors dream? Or, is there really a valid reason for automating libraries?

Automating library functions is one of the most effective uses of computers today. Library personnel have a tremendous amount of tedious, detailed tasks to perform. Ordering , cataloging, and distributing of materials. Circulating books, preparing overdue notices, reference searching, and verifying check-ins. All these repetitious duties are done manually , thus wasting the valuable resources that qualified library staff members possess.
An automated system, collecting all related data in one place, would create a more proficient running facility for library staff and patrons.

From a patron viewpoint, using the library can also be extremely cumbersome. The card catalog provides information to users seeking materials, however the time consuming process is often abandoned in frustration.
An automated library system in a college environment can prove to be one of the most valuable learning tools that a student can use. Instead of spending endless hours investigating a topic, an automated system can provide this information in a fraction of the time. Thus, freeing the student to begin researching the materials. In addition, Library Automation paves the road to faster inter-library loans, whether across town or across the state, providing the library patron with virtually endless amounts of information on any given topic.

Automating libraries also provides easier methods for cataloging new acquisitions, producing overdue book notices, preparing annual inventory reports and automating the preparation of catalog cards and spine labels. In addition, it would better utilize all available titles.

THE HCC LIBRARY AUTOMATION EXPERIENCE

Hillsborough Community College (HCC) made the decision to move into the world of library automation during the summer of 1985. Like any large project there are certain prerequisites which must be obtained prior to commencement:

- Define objectives and goals
- Administrative support of the project
- Financial support of the project
- Knowledgeable individuals dedicated to the project
- Sufficient personnel for the project
- Participant enthusiasm for the project

All of these prerequisites were obtained at HCC, some easier than others. Staff members from each of HCC's four campus libraries formed a Library Automation Committee. This committee worked together to determine the goals and objectives. These were outlined as follows:

- The master union catalog must be accessible at all four campus locations. This allows all libraries to know what other campus holdings contain.
- Each campus must be able to automate their circulation tasks.
- Each campus must have access to the status of other campus circulation records.
- The capability to tie into local and state library systems. Therefore library record standards (MARC record format) had to be implemented and maintained.

Our next hurdle was obtaining funds for the project. As a result of two newly acquired systems for Academic (VAX 11/780) and Administrative (IBM 4381) computing, the financial support available was limited. What is limited? The directive not to exceed $20,000.00 was cast.

To automate a library on $20,000.00 is a simple task....for a single location, 20,000 title library. However, Hillsborough Community College has four academic campuses and a minimum of 50,000 titles. Obviously the work had been cut out for the project team members!

Finding a librarian that understands computers is as difficult as locating a "computer-person" that knows the workings of a library. Fortunately for the project, HCC managed to combine several different people to cover every aspect. A computer-literate library staff member joined forces with a member of the Computer Center staff (not library-literate) to form the automation team. One of HCC's librarians was appointed project leader for the retrospective conversion process.

Once the translation of each member's language was complete, the three joined forces and began educating both administrators and library staff members. This not only generated enthusiasm and support for the project, but also enticed more personnel to work on the time-consuming conversion process.

SOFTWARE

Research on various library automation packages was conducted by both members of Data Processing staff and the Library Automation Team. The market of such software is not very large, therefore all the systems which could be used in HCC's environment were investigated. The Data Processing Department inquired at other college sites for the kind of software being used for this purpose as well as contacted various vendors. Members of the library automation team concentrated primarily on software for micro-computers in order to keep costs at a level which could be realistically addressed.

The process of elimination was conducted by comparing the specifications of the software to the list of HCC's objectives. Any product unable to fill all requirements was discarded. Software priced within the correct range was then reviewed. After a lengthy term of research and evaluation the library automation team chose two software packages which met all the needs outlined in their objectives: BiblioFile Catalog Production System and Ocelot Library Systems.

BiblioFile Catalog Production System:

The BiblioFile program, marketed by The Library Corporation of Washington, D.C., is a Laser Disc Based Catalog. This system is designed for a retrospective catalog conversion process, as well as for current catalog maintenance.

A set of compact laser discs containing a database of the entire Library of Congress MARC format records accompanies the software. The software provides the utilities required to scan the database for records which match the holdings found at the 'user' library. When a match is found a new site-specific MARC format union catalog entry is created.

When a specific record is selected it can be edited if necessary before saving it to the site-specific database. This eliminates the need to manually type all the HCC holdings individually into a database, a much more cost-effective process than could be achieved by contracting an outside agency. Therefore, BiblioFile will not only save time on the retrospective conversion process, but will cut costs.

The concept of building the HCC catalog with MARC records is technically advanced. Using this international standard record format, the objective of eventually integrating HCC's system with the State University Automation System could easily be realized. If the records were entered manually, the large amount of information that makes up a MARC record would probably not be included. In addition, the accuracy level would be below the near 100 % of BiblioFile.

BiblioFile will provide several benefits to HCC's libraries. First, it will assist in the retrospective conversion of the 50,000 titles included in HCC's collection. The state-of-the-art laser disc technology provides a productive, cost-effective method to perform the conversion in-house. The utilities will also accommodate ongoing cataloging for new acquisitions.

Ocelot Library System

The Ocelot Library System, available from ABALL Software, Inc., Canada, is a full service library automation package. This system consists of three modules: Catalogue, Circulation, and Purchase.

The Catalogue module accepts MARC records from BiblioFile, storing them under Authority Control (names, subjects and titles). It will also support entries of local catalogue records. This module provides on-line Inquiry of records, including boolean searches (and,or,not) and cross reference features such as "see" and "see also." This program is interfaced with the Circulation module, and will provide circulation status of all holdings. All campus libraries will access this module.

The Circulation module is designed to support the Catalog Module. All standard circulation functions are supported by this module. For example: check-in / out status, renew option, reserve book status, overdue fines, payments and notices are maintained here. Status reports on all circulation information, such as overdue listings, may be produced, both on and off-line, daily, weekly, or monthly.

An optical wand to read preprinted barcodes is available to interface with the Catalogue module. By running the wand over the barcode (optionally entered in the catalogue module), the book information is automatically generated for the librarian. This module does not have networking capability, therefore each campus supports their own circulation module.

The impact of maintaining individual circulation modules on each campus is minimal. Each campus will access its own files by default. Each campus will have read-only access to other campus circulation files, however, in order to view whether a book is available for check out.

The Purchase Module is an acquisition package which can support up to 15,000 orders per year. Capabilities range from Request to Purchase to Payment Vouchers. In addition, items such as Full fund accounting, including Summary Funds; online Vendor File, Claims, Cancels, Returns, and Status requests are all included. Proper security options are available for this module, although Library Technical Services would have sole access.

The Ocelot Library System software is very easy to use. Once the database has been built, very few keystrokes will obtain information concerning all four campus library's holdings. The search keys to call this information is flexible, thus encouraging multiple searches. The Circulation module will automate repetitious record-keeping functions. Lastly, the Purchase Module will maintain important acquisition records and orders, and complete the loop of automating library tasks.

HARDWARE

While researching the library automation software options, various hardware configurations were investigated: IBM mainframe, DEC-VAX mainframe, Micro-network with File Handler, and Micro - Standalone at each library site.

Research uncovered some expensive software to run on the mainframe options. As much as this software would benefit and meet the needs of HCC, the Library Automation Team had been made aware of the budget constraints for 1985-86, and were looking for a package whose cost could realistically be proposed for a state grant.

The micro-network concept was an interesting one, however, since the college currently supports two campus-wide networks and their accompanying communication lines, it was determined that a third network and all the required communication equipment would not be the most cost efficient for the college at this time.

The stand-alone micro-computer had only a few software options from which to choose. Due to hardware/storage constraints, most would only support a small library collection. The BiblioFile system was attractive as it supports up to 50,000 titles, as a result of utilizing the laser disc technology.

Late into the research, "CARDWARE" , a hardware/software solution for gaining access to MS-DOS from a DEC mini-computer (such as the VAX 11/780 currently installed at HCC) was discovered. CARDWARE, manufactured by Logicraft, Inc. of Nashua, N.H., is comprised of two parts -- a board with 3 micro-processors on it, installed into the Digital CPU, and the MS-DOS software which runs as the operating system on the micro-processors. The results are the same as MS-DOS running on an IBM-PC, however the hardware/storage constraints of a micro are eliminated. Therefore, by adding additional disk storage to the VAX, HCC's Union Catalog would have unlimited growth capacity.

This hardware option also made it possible to load the Ocelot Library System software onto the VAX, thus making it accessible at all campuses. To implement this option, the HCC Union Catalog would be derived from the BiblioFile laser disk, and "uploaded" to the VAX using communication software called Dataware (also produced by Logicraft). This will make the Union Catalog database available at all campuses and accessible to Ocelot as well.

IMPLEMENTING THE SYSTEMS

Implementing the Systems...the fun begins!
The proposals and recommendations looked viable on paper, the time had come to see if it would really work!

The compilation of an implemenation schedule was a challenge in itself. No one has a system configured like HCC's, thus there were no models to follow.

The installation of micro, single-user software into a mini, multi-user environment was an overriding consideration throughout the project. The simplicity of software running on a single micro unit had disappeared. HCC pioneered into utilization of yet another state-of-the-art technology...CARDWARE...MS-DOS software running on a VAX.

BiblioFile and Ocelot are separate software programs performing separate functions within the Library Automation project. Therefore the decision was made to begin the retrospective conversion first, and become as familiar as possible with BiblioFile capabilities before embarking into Ocelot.

Training personnel in BiblioFile was a simple task. The difficult part was eliminating the hostility that the staff held toward computers in general! HCC's master shelflist was matched with the Library of Congress MARC database. When a hit was made, minor editing was performed (year of publication, campus location) and the record was saved. If the record required editing by a cataloging librarian, a partial hit or no hit was recieved, then the card was flagged to be edited at a later session.

This process proceeded slowly in the beginning, however as the staff became more acquainted with the system the conversion process went faster.

Ocelot was installed approximately two months after BiblioFile was started. The installation into the CARDWARE boards went smoothly. Some tailoring to the unique configuration of the hardware was required, however once this was done the installation was fairly straightforward.

The implementation plan called for uploading of a predetermined number of records (50) into Ocelot's database. Testing of the Catalog Module and Circulation Module was to follow this step. It was at this point that the project slowed and some reevaluation of the implementation plan was made. It was soon discovered that the fields which were added to the MARC record in BiblioFile were not automatically recognized in Ocelot. Additionally, Ocelot expected information to be included in specific fields that BiblioFile did not generate.

These problems were not detected at a stage too late to correct them. Approximately 2500 records had been added to the database. These records were deleted from the database, edited where necessary, and re-added via a new conversion table. The set back only encumbered a two week period.

A new consideration made its way to the priority list at this phase; Ocelot was designed for public library use, not academic library use. There are differences, fortunately most of which are additional information fields provided for public library use which can be ignored in HCC's academic installation.

Once the Catalog Module met all HCC's requirements and the database was rebuilt, demonstrations were scheduled for all library staff members. Three seminars were held, Introduction to the VAX, "How to BiblioFile", and "How to Ocelot--the Catalog Module". These demonstrations were held at each campus with groups of three or less. They were very successful and assisted in generating a lot of enthusiasm and questions and "wishlists" from the library staff. It is the intent of the project team members to continue to schedule these short demonstrations throughout the implementation to alert all staff members to new features as well as maintain their interest in the project.

The Circulation Modules were installed at the point when all were satisfied with the status of the Catalog Module. Each campus will have on-line access to their own circulation module, and read-only access to the other libraries' circulation modules.

Weekly status meetings are attended by the project team members. Monthly meetings of the original Library Automation Committee are held. A monthly status report is issued to all library staff members and administrators.

FUTURE IMPLEMENTATION STAGES

There are several phases to the project which have yet to be implemented.

Barcoding The project team members are currently investigating the best alternatives for obtaining barcode labels for the books. There is a field within each book's record to store the associated barcode. Therefore when a student brings a book to be checked out the barcode will be scanned, bringing the book information to the screen. The student will be issued an HCC library card, that is barcoded, which will be validated each term.

An additional use of barcodes on books will be to automate annual inventory. The master database can be divided into campus collections. Once the inventory data has been collected a comparison of the two campus listings will provide an accurate listing of missing materials.

Overdue Notices The Circulation Module produces reports of overdue books and patrons holding those books. Data from these reports will be used to obtain student addresses from the student system and overdue notices will be produced.

The Purchase Module will be installed on a stand-alone micro system. It will be maintained by District Library Technical Services.

Currently each library has one terminal connected to the Library System. Future plans anticipate more terminals will be installed to provide on-line searching by students.

The Tampa Bay Library Consortium has approached HCC to consider sharing their database with other members of the consortium, as well as storing other members records on HCC hardware for external access.

All libraries are expected to go on-line during the summer of 1987. The retrospective conversion is expected to be fifty percent complete by this time.

Recommendations for your Library Automation Project

1. Define what the needs of your library are, prior to beginning to research software.

2. Establish guidelines; financial, physical (i.e. hardware, staffing, etc.)

3. Determine all standards and long term implications. Will the library tie into a state or local library network? Will the size of the library drastically increase over five years or maintain status quo?

4. Must be a team effort. Include members of your library staff, representatives from your Computer Center, and key administrators.

    1) Educate your team members!

        a. Teach your library members the basics of computers.

        b. Teach your computer center representatives the basics of library science.

        c. Teach your administrators a little about both!

    2) Meet regularly to report statuses and maintain enthusiasm for the project

5. Develop a method to filter all automation information to entire library staff , during research and during installation. This will alleviate any fear or threat caused by unknown concept of 'library automation'.

6. Appoint a project leader on both computer and library sides. This will promote project organization and give related personnel a contact person. Good implementation schedules must be followed and maintained.

7. Finally, once the installation is underway, don't stop your research. Always keep abreast of new concepts and technologies.

POLICY AND ORGANIZATION OF COMPUTING, COMMUNICATIONS AND LIBRARIES IN DIVERSE UNIVERSITY SETTINGS

Jack A. Chambers
Duquesne University
Pittsburgh, PA

Jerry W. Sprecher
The California State University
Long Beach, CA

ABSTRACT

This paper briefly reviews current policies and organizational patterns in higher education nationwide, especially as they relate to the converging technologies of computing, communications and libraries. Case studies are provided from two distinct types of university settings — The California State University, encompassing 334,000 students on 19 campuses, and Duquesne University, a long-established, small, private eastern university. Suggestions are provided regarding policies and organizational patterns which appear most profitable in handling the converging technologies so as to maximize service and minimize costs.

POLICY AND ORGANIZATION OF COMPUTING, COMMUNICATIONS AND LIBRARIES IN DIVERSE UNIVERSITY SETTINGS

INTRODUCTION

Computing was first seen in higher education in the late 1950's and early 1960's, primarily in the mathematical and statistical laboratories of the major universities, and in Schools of Business providing the power to drive business simulations. Batch processing dominated these early scenes, in which large mainframe computers serviced an ever-expanding number of clients. Use first spread to the financial and student records areas of the administrative arm of the campus. With the advent of time-sharing computing in the late 1960's and 1970's, usage quickly spread to other areas of the campus. The arrival of the microcomputer in 1980, along with the instantly popular spread sheet and word processing software, brought down the last bastion of defense in higher education -- the humanities. Today the computer finds use in literally every area of the campus, so that what was once a departmental resource and problem must now be considered a campus-wide resource and problem.

The problem part of computing, of course, relates to the development of policies and organizational structures which result both in good service and the feeling on the part of all clients that they have been treated fairly. And this must be done at the least possible cost....

The high cost of computing has led to many basic policy decisions in higher education, not the least of which was the decision to centralize computing services on many campuses in the early use period. Separate centers for instructional/research and administrative computing developed primarily only on very large campuses where the economy of scale provided the rationale. As usage continued to grow, however, and as more and more institutions viewed computing as a campus-wide resource, the trend towards one central coordinating office continued.

During the early 1980's, along with microcomputers and office automation software, came the need for data communications. The rise of the communications industry followed. The need to automate university libraries began to emerge in the 1970's, and by the early 1980's had become one of higher education's most pressing concerns. Most recently, developments in artificial intelligence offer significant improvements in software capabilities in the near future, and, of course, much is likely to be gained from this current revolution. As Jack McCredie stated in the early 1980's, writing as the president of EDUCOM:

> Higher education in this decade will be rocked by waves of change caused by the converging technologies of computing, high-speed local and satellite digital communication, video disk and other large capacity information-storage devices, graphics, two-way cable systems, and artificial intelligence applications. (McCredie 1983)

These predictions have so far proven quite accurate. Applying these to higher education campuses which have struggled to make the most use of computers since their introduction, McCredie (1983) and Updegrove (1986), identified a number of factors characterizing these campuses in regard to information technology, as follows:

1. A single coordinating office
2. A decentralized information-processing environment
3. An understanding of the need for personal workstations
4. The development of local and campus-wide networks
5. A focus of automation on university libraries
6. A university-wide thrust in the area of computer literacy.
7. An interest in text processing
8. An enthusiasum for electronic mail
9. An increasing emphasis on the use of computer-based education (CBE) methods (Chambers and Spreacher, 1983).

We would add to the above:

10. An increasing use of artificial intelligence in the development of expert systems and intelligent tutors for CBE projects (Sleeman & Brown, 1982)

Finally, organizational patterns in higher education institutions across the country today are reflecting the increasing importance of computing, with many campuses creating Associate Provost or even Vice-President positions encompassing computing and communications, and sometimes library, instructional media, and office service components.

CASE STUDIES

The California State University

The California State University (CSU) consists of 19 campuses and covers more than 1,000 miles from Humboldt State University in the north to San Diego State University in the south. The system enrollment now exceeds 334,000 students and employs over 19,000 faculty. The entire system is linked by a highspeed, data communication network commonly called CSU net or the CSU X.25 network. This network allows any student or faculty member to access any computer within the system.

Policy and organization for computing and communications are addressed through the Information Resources Management (IRM) process which is an annually updated, five year plan for the system. It is based upon the 19 individual campus IRM plans. The IRM planning process is a topic of a separate paper which will be presented as part of the "Policy Issues in Higher Education" track of this conference. This section will focus on specific campus goals, objectives, needs and their visions of the future.

Three campuses have been selected to represent a cross section of the CSU. These campuses, Chico, Sacramento, and Northridge, were selected due to their size, geographic location and areas of specialization in computing and communications.

Since each of the three campus plans is several hundred pages long, and since the plans are dynamic in nature, the case studies are presented in terms of highlights which show the flavor of the plan rather than the detail. In addition, since Library planning is separate from the IRM process, activities in that area will be presented first and cast as systemwide activities. Following the Library discussion, each case study will be presented with brief conclusions presented at the end.

Library Resources

The planning for IRM activities in the library area has been coordinated by the Library Affairs office within the Chancellor's Office. CSU libraries rely on the CLSI System which is a DEC-based, turnkey system for circulation control. Additionally, the libraries utilize PC-based, video disk access devices and also access external resources such as the OCLC system and MEDLINE library.

Currently, pilot efforts are underway to install OLPAC (On-Line, Public Access, Catalog) systems on a systemwide basis. CSU Chico has an OLPAC system installed and the Northridge campus has a procurement underway. These sytems will replace the CLSI systems and enable library users to access the "card catalog" via computer workstation, even from home or the dorms. In addition, planning is underway at the Northridge campus to implement an Automated Access Facility which consists of compartmentalized library shelving systems with a robotics-like retrieval component that allows a user to secure library material via OLPAC without library staff intervention.

CSU, Chico

California State University Chico is located in the northern portion of California's Central Valley. With an enrollment of 14,145 students and a faculty of 1,045, Chico is classified as a medium sized CSU campus. Chico has taken the leadership in many technology related projects and currently has an extensive distance learning program which utilizes ITFS and satellite video transmission facilities.

The IRM organization at Chico reports to the President through the Provost and Vice-President for Academic Affairs. The IRM program designee is the Associate Vice President for Information Systems who is responsible for the Instructional Media Center, the Computer Center and the library.

Highlighting the goals and objectives of the campus are:

1. Creation of a fully networked environment with access via workstation to central and distributed computer nodes;
2. Access to modem video capabilites;
3. Increased training;
4. Improved information software tools; and,
5. Consolidated equipment maintenance budgets.

To achieve these goals, the academic related needs have been identified as student access oriented. That is, there is a need for student access to word processing, computer graphics, spreadsheets, etc. Access is also a present need for the academic administration for such items as access to networks, access to office automation capabilities and access to library resources. In addition, a third area of need can be generally categorized as a need for increased capacity in the categories of professional staff, maintenance and training.

Chico has projected it's future as including a professional workstation for each professional staff member and a clerical workstation for each clerical position. In addition, training programs in literacy and application skills will be provided for all employees. In terms of mechanics, the backbone network is anticipated to utilize a broadband medium such as fiber optics and carry voice, data and video transmissions.

CSU Sacramento

California State University Sacramento is located in the north-central portion of the state's central valley. With 23,000 students and 1,300 faculty, Sacramento is classified as one of CSU's largest campuses. The campus has a strong IRM program and currently serves as CSU's pilot campus for computer conferencing and the PLATO CAI project. In addition, the campus has installed a supercomputer and provides a supercomputer training program for the system.

The IRM organization reports to the President through the Executive Vice-President who is the IRM program designee. Computing services report to the Executive Vice President. Sacramento's objectives include the establishment of a voice/data network. Significant progress has been made in this regard with the installation of the campus AT & T System 85 and related ISN. Other objectives include migration from central word processing to a distributed system; increased faculty, staff training, increased computing resources; and data base access with 4GL, report generators, etc.

To achieve these goals, academic needs have been defined to include expanded faculty and student access; expanded support for large research functions, increased CAI capabilities; and expanded resources both in terms of the campus network and the campus mainframe computers.

In terms of administrative needs, improved online systems with query/update capabilities and an expanded number of interactive ports have been identified. In addition, modern office automation tools and replacement of older, COBOL-based systems are needed.

Sacramento's future is envisioned to include elimination of current workstations through replacement with microcomputer-based workstations, including word processing applications. In addition, a common, 4GL capability for mini, micro and mainframe computers will be pursued. Finally, an expanded faculty/staff learning center will be established.

CSU Northridge

California State University Northridge is in the northern part of the Los Angeles basin. It is also one of CSU's large campuses with an enrollment of 29,000 students and a faculty of 1,700. The Northridge campus has a long history of significant IRM-related activities including serving as the CSU's Southern Regional Data Center in the 1970's and later providing leadership in pioneering office automation in the system. Today, Northridge serves as the Specialization Center for the ICEC (Inter-university Consortium for Educational Computing) project and is developing software for advanced workstations.

The IRM organization at Northridge reports to the President through the Vice-President for Administration and the Vice-President for Academic Functions. The computer center, via the Director of Information Management, reports jointly to these two vice presidents. The Vice-President for Administration is the IRM Program Designee.

The goals and objectives at Northridge include a desire to establish a microcomputer-oriented computing environment. Included in this concept are goals to increase the usage of graphics and electronic publishing; to establish guidelines and standards for acquisition and deployment; and to provide discipline specific faculty training. Other goals involve the transition to a 4GL administrative computing environment, installation of a university-wide hierarchical network, and replacement of the Centrex telephone switch.

Current academic needs relate to access and are defined as the need for improved student and faculty access to computing resources. The non-academic needs include a short-term need of increasing the current mainframe capacity and the long term need to acquire state-of-the-art computing hardware, software and productivity tools.

The projected future environment includes an expanded microcomputer lab, and bridge software to allow communications between the Cyber, Prime, AT & T, PDP, IBM and Apple computers. In addition, standard, low-cost microcomputer software is envisioned with instructional software development for advanced workstations.

Duquesne University

Duquesne University, a private, Roman Catholic university with a current enrollment of 6,600 students, was founded in 1878. Set on a hilltop overlooking downtown Pittsburgh, the university is highly selective in admissions. It offers training through the doctorate and is most well known for its schools of law, business and pharmacy.

Duquesne is not a heavily scientific-oriented institution. Therefore, computing came late to the campus, and a single central coordinating office was not developed until 1980. At that time the Arthur Anderson firm served as consultants in the development of a five year computing plan for the campus (Anderson, 1980), which emphasized administrative applications. More recently, in the spring of 1985, a new Vice-President for Management and Business was appointed, and in December, 1985, a new Director of Computing and Management Information Services (the senior author of this paper) was appointed. A Computer Steering Committee, representing all general areas of the campus was created, and the college and schools of the university were requested to develop five year academic plans, of which computer usage was to be defined as one of the major components.

The new Center director arrived in February 1986, appointed a Task Force on Instructional/Research Computing with one representative from each college and school, and a Task Force on Administrative Computing, with representatives from each major non-teaching area, including the University Library and the Law Library. He met with the college and school computer committees and participated in the deliberations which resulted in the completed five year computing plans. The non-teaching areas then developed long-range computing plans.

All of these plans then served as the bases for the development of a five year university-wide plan for computing and communications (Chambers, 1986). The plan was reviewed during October and November and received final approval by the computer advisory committees in early December, 1986. It is currently under review by the President and Vice-Presidents and is expected to be approved for implementation in January, 1987.

The overall purpose underlying the integration of computers into the basic composition of Duquesne University is to enhance the intellectual and motivational capabilities of its students, its faculty and administrators, and its staff (Chambers & Sprecher, 1983). Major goals of the plan include the following:

1. Achieve computer literacy for students, faculty, administrators and staff.
2. Integrate the computer into the curriculum.
3. Enhance the work environment of the entire Duquesne community through the computer.
4. Provide support for the development of undergraduate and graduate programs of excellence in information science and related fields such as computer science and management information systems.
5. Provide support for development of research projects and institutes of the highest calibre in the information sciences area.

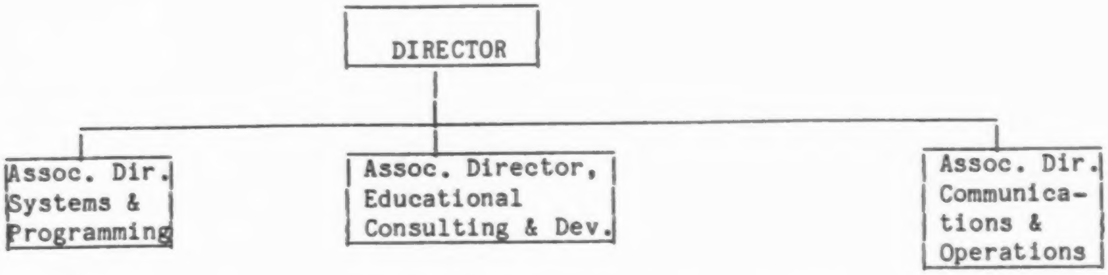
The results of the long range plan over the next five years are expected to include the following:

1. Workstations for all faculty, administrators and staff who need and desire them.
2. A fiber-optics communications network connecting all buildings on campus, with gateways to the major external networks and data bases (Hecht, 1985; White, 1985).
3. Office automation tools for all university offices, faculty and staff, including electronic mail, calendaring, word-processing, spread sheets and data base management tools, with access from all work stations to all campus computing resources and the campus libraries.
4. Integrated, on-line management information systems.
5. Completely automated libraries, both the university library and the law library.
6. A Center consulting and development staff providing consultation and training campus-wide.
7. Student computer labs in every university classroom building and dormitory providing creative writing and other computer-assisted instruction programs, electronic mail, word-processing, spread sheet and data base management tools and access to all campus com-

puting resources and the collections of the university and law libraries.

8. A new computing facility and a new campus mainframe computer.

The Center reports to the Vice-President for Management and Business, and has been reorganized as follows:


DIRECTOR
Assoc. Dir. Systems & Programming
Assoc. Director, Educational Consulting & Dev.
Assoc. Dir. Communications & Operations

As may be noted, communications has been made an integral part of the Center. Although the university library reports to the Vice-President for Academic Affairs, and the Law Library to the Dean of the Law School, the directors of both of these units serve on the newly-formed Task Force on Administrative Computing, and are fully cooperative with the Center in the development of automation plans. The University Library, in conjunction with the Center will shortly open a Software Resource Center and a Computer Laboratory in the library building.

Overall, the thesis of the Center for Computing and MIS is service. The strategic Center policies may be defined in brief as follows:

1. Consult, rather than conspire
2. Cooperate, rather than compete
3. Never take anything too seriously, especially yourself.

CONCLUDING COMMENTS

The IRM process in The California State University reflects the CSU posture to place the responsibiliity for campus IRM planning at the campus level. Based upon the combined results of the 19 individual campus plans, systemwide strategies can be developed. The case studies above, for example, indicate that there are some goals and needs which are common among campuses. These would include the need to improve faculty and student access to computing resources and to expand existing resources especially for administrative computing. These common needs represent areas where systemwide efforts could be of significant benefit in terms of leveraging quantity discounts, promoting standardization, etc.

Other goals and needs are unique to a campus or a subset of campuses and do not justify the added complexity of systemwide coordination. However, a third area of opportunity exists which is not reflected in the case studies. A management model that addresses this need is presented below.

Management Models. The California State University has implemented a managment model to facilitate innovative use of technology. The model is related to a newly created organizational structure called Academic Computing Enhancement (ACE) Institute.

The ACE Institute is governed by a subcommittee of the systemwide Academic Computing Planning Committee. This committee structure provides representation from the nineteen campuses and the Chancellor's Office. The model was created as an interim solution to the "justification" barrier to implementation of new and innovative computing technology.

This problem arises in the formalized budget processes which utilize a Feasibility Study Report (FSR) type justification and require "assurances of success". Typically, the assurance is provided through use of proven technology (e.g. it is not new or experimental). In addition, a demonstrable need must be evident (e.g. how many students will not graduate if this is not implemented?).

The process generally follows the negative, circular cycle below:

No Experience with the new technology
!
No "FSR Justification" possible
!
No funding justified
!
No experience with the new technology

The solution has, in the past, been to wait for other universities to "prove" the technology and then to justify through comparison. That is, to detail how CSU needs are similar to the existing proven situation. Today, however, with rapidly changing technolgy, this procedure mandates utilization of outmoded technology.

The ACE approach provides an alternate method for application of new technology. The process begins with support of an innovative proposal by the ACE committee. The Project is then funded on a pilot campus basis. However, the project must be systemwide in nature, usually through use of the CSU X.25 data network. The funding is normally on a shared basis with the pilot campus participating in the support.

The other eighteen campuses within the CSU gain experience with the technology during the pilot project and develop curricular materials. Therefore, at the end of the pilot, FSR-type justification can be developed and based upon limited, but actual experience.

An example of an ACE project is the Molecular Design Laboratory for which CSU Fullerton is serving as the pilot campus. The project is designed to permit CSU Chemistry faculty to gain experience with computational chemistry concepts. The Molecular Design software package was the initial package acquired.

Funding for the project included approximately $150,000 for computing equipment (a Prime 9755 super minicomputer), graphics boards, software, project director's travel, etc. The campus commitment included released time for the project director, space, facilities management for the equipment, and use of terminals, plotters, etc.

Systemwide involvement was insured through the negotiations of systemwide software licenses, remote access of the software via the data network, a computer conferencing facility, and systemwide training and support.

In terms of projected future activities, it is envisioned that selected campuses will implement "clone" environments based upon their experience with the pilot center. In addition, the pilot center is being expanded via NSF instrumentation grant proposals. Finally, as the complexity of the projects increase, more advanced problems will require access to the San Diego Supercomputer Center via the CSU Network.

The ACE concept is effective in the current CSU environment in establishing pilot centers and in effecting technology transfer to participating campuses through the creation of a low risk environment for experimentation. The ACE concept is also being used for other CSU innovative projects such as: the Inter-university Consortium for Educational Computing; Computer Assisted Design/Computer Assisted Manufacturing; computer conferencing; and supercomputer training.

Single Campus Organization. Returning to a single campus environment, and considering the importance of the computing and communications functions to the overall mission of higher education, it would appear that an organizational pattern including a Vice-President for Communications and Information Technology would be profitable. This administrative unit could then encompass computing, communications , the library and media areas (including television), office publishing, and continuing education. The only major new area which has not yet been associated with information technology is continuing education. If this area is considered as a form of distance learning, in which instruction is brought to the student rather than vice-versa (which in reality should be the case), then computer-based education, down-loading through cable TV, and the like, all fit the management pattern for information technology.

REFERENCES

Anderson, Arthur & Co. Duquesne University Long Range Systems Plan. Pittsburgh: Arthur Anderson & Co., 1980.

Chambers, Jack A. A Master Plan for Communications and Information Technology at Duquesne University, 1987-1992. Pittsburgh: Center for Computing and MIS, Duquesne University, 1986.

Chambers, Jack A., & Sprecher, Jerry W. Computer-Assisted Instruction: Its Use in the Classroom. Englewood Cliffs, N.J.: Prentice-Hall, 1983.

Chambers, Jack A., & Sprecher, Jerry W. Computer-Assisted Learning: Motivating Students for Lifelong Learning. In B.S. Alloway and G.M. Mills (Eds.), New Directions in Education and Training Technology. London: Nichols Publishing Co., 1985.

Heebt, J. "Fiber Optics Lights Up Networks." PC Magazine, March 5, 1985, pp. 169-175.

McCredie, Jack W. (Ed.) Campus Computing Strategies. Bedford, MA: Digital Press, Digital Equipment Corp., 1983.

Sleeman, Derek, & Brown, John S. (Eds.) Intelligent Tutoring Systems. New York: Academic Press, 1982.

Updegrove, Dan A. "Computer-Intensive Campuses; Strategies, Plans, Implications" EDUCOM Bulletin, Spring, 1986, pp. 11-14.

White, L. "Fiber-Optics" Computerworld Focus, 1985, 19, p. 36A.

DEVELOPING TECHNOLOGY ASSISTED LEARNING (TAL) CENTERS

by

Marion J. Ball, Ed.D.
Associate Vice Chancellor, Information Resources
Professor, School of Medicine, Department of Epidemiology
Professor, School of Nursing
University of Maryland at Baltimore

Acknowledgements

The author would like to formally acknowledge Judith V. Douglas, M.H.S., Director for Planning and Management, Information Resources Management Division, University of Maryland at Baltimore, for her assistance in developing this paper.

DEVELOPING TECHNOLOGY ASSISTED LEARNING (TAL) CENTERS

Introduction

The development of computer applications in health care is accelerating at a bewildering rate. As technology improves, the costs of automated data processing decline, spurring new applications. Issues that were discussed at major national meetings three years ago are no longer relevant. We cannot anticipate the issues three years from now. What we do know is that the computer is transforming the way we conduct our lives and our business.

That computers will increasingly pervade the environment of the academic health center is not in doubt. Economic and technical forces will compel change. What is in doubt is how the change will be managed. The task if done well should be proactive, and not reactive.

> "There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institutions, and merely lukewarm defenders in those who would gain by the new ones."
>
> Machiavelli, **The Prince**

The task of managing the information resource in the academic health center is not easy. Hard choices must be made if change is to take place. Admittedly complex, the academic health center can be understood as a system. The inputs to the system are students who require an education, patients who need care, and the resources necessary to those tasks. If the process is successful, the outputs are trained health professionals, treated patients, and that unique product of the academic environment -- contribution to new knowledge. Central to the system and its functions of education, clinical care, and research is the transfer and/or application of information.

The mission and tasks of the academic health center are education, research, patient care, and public service. Effective management of information is essential to this information intensive environment, yet in the majority of institutions the management of information is inefficient and awkward to the detriment of the education, research, and patient care objectives.[1]

Information Resources in Education

As an educational institution, the academic health center faces two major tasks in the area of information resources management. First, the faculty must educate the student about information processing and its applications. Second, the faculty must begin to use the enormous potential of the computer to instruct. Failure to address these issues within the next four years can have serious consequences. Universities are requiring personal computers upon matriculation (Carnegie-Mellon, Drexel) and are wiring their campuses for access to central computing from every dormitory room (Brown University). As the students from these schools move into our health sciences centers, the mismatch of students to this environment will not be trivial!

The term computer literacy is widely used to convey the concept that every student should be exposed to and be comfortable with computerized information processing. Many in the field diverge, however, on precisely what literate means. The student should not only be acquainted with the anatomy (or hardware) and physiology (or software) of the computer, but should be capable of using existing software packages to produce a product. It is not intended that the student be engaged in programming or coding activities in his or her professional career, rather that the process provides and emphasizes a true feel for what is involved -- the power of the technology and the limitations of the computer.

It is estimated that the biomedical information base doubles every 7 to 10 years; the halflife of this information is only 5 years. For more than 15 years, faculties within our academic health centers have conceded that it is mandatory that we develop instruction in problem solving, and evolve tools and techniques that will encourage self directed learning.[2] That message is at the core of the AAMC Preliminary Report on the General Professional Education of the Physician.[3] Yet virtually all of the instructional effort of medical colleges is mired in the didactic lecture format. In general, faculties are resistant to change -- notwithstanding a few successful models which are well known.

The tools are at hand to bring this universally accepted concept of self directed education to fruition. The chief administrative officer of the academic health center must deploy the resources to encourage and allow the development of effective, state-of-the-art computer assisted instruction and students must have access to the various data bases currently available.

A strong note of caution is indicated. More than 60 percent of medical schools report some utilization of computer assisted instruction. In most instances the capacity resides in stand alone systems and is rarely reposited in a language compatible with potential clinical data bases. CAI programs are usually outside the mainstream of the educational effort of the school. They are viewed by many of the faculty as irrelevant. Computer based education must move beyond electronic drill, practice, and page turning.

Innovative programs have been developed at a number of health sciences centers. Those developed at the Massachusetts General Hospital, Ohio State, Illinois, and McGill in Canada have been widely reviewed. A number of excellent programs reside on a variety of health education networks. All of these programs emphasize independent learning where the student can apply critical and analytic abilities to problem solving as opposed to being burdened with unnecessary (and unmanageable) memorization.[4]

Computer based instruction that would represent transformation of learning is harder to come by, but such programs are on the way. Manning cogently points out that it is now possible to weave education so closely to the practice of medicine that it would be difficult (and probably not relevant) to separate the two.[5] Patients can be indexed by problems and conditions. Practice profiles can be created. It is easy to supply information at the time and place where the physician or student is developing diagnostic and therapeutic plans. Any networked work station may access such existing data bases as the AMA/GTE network and such future public domain data bases as CADUCEUS, MYCIN, ONCOCIN, HELP, REMINDER, and ARAMIS. The prospects are limitless.[6]

Prospects are also proliferating in the management of bibliographic information and print resources. In a manner unmatched in any other academic medical endeavor, medical libraries in this country are extending their services through information technology, with the result that librarians today are in effect information resource managers.

Currently there are over 160 bibliographic data bases. Searches can be made by author, title, subject, or cross referenced subjects. Abstracts can be scanned; in some data bases, whole papers can be called up and printed out. In addition there are at least 900 other numeric and information data bases that can be used for online searching by libraries. Commercially available bibliographic data bases, such as the AMA/GTE network, are available with other (drug, diagnostic) data bases that will provide the physician/researcher of the future with efficient and reliable literature searches. Anyone with a terminal and a modem may access any and all of these.[7]

The definitive document exploring new roles for libraries has been written by Matheson and Cooper.[8] It underscores the need for the health scientist to become thoroughly familiar with the resources available and the need for the health science librarian to be an expert in information technology. We must encourage the merging of medical information scientists and planners, often referred to as medical informaticians, with the librarian information broker.[9]

DEVELOPMENT OF TECHNOLOGY ASSISTED LEARNING CENTERS

Initiatives at the University of Maryland. With funding from the National Library of Medicine, the Campus for the Professions in late 1983 entered into a three part process for the strategic planning, model development, and eventual implementation of an integrated academic information management system (IAIMS). Central to the IAIMS concept was a vision of a networked, distributed system serving the entire campus. This system will link the six professional schools and the graduate school, extending the power of their individual microcomputers through local area networks and through gateways to a mainframe database management system and fourth generation languages.

Responsible for the pilot implementation of this system are the Information Resources Management Division (IRMD) and the Health Sciences Library (HSL), which together serve as core facilities, providing a full range of services to the campus community. This alliance builds upon the base established by the HSL as the first fully automated medical library in the United States, and allows the University of Maryland to be at the forefront of the national trend towards merging the computing center and the library.

In 1985, the University of Maryland Campus for the Professions began its plans for a system of Technology Assisted Learning (TAL) Centers. Moving beyond an information center run primarily for administrative users, the Information Resources Management Division (IRMD) in 1986 established two TAL Centers, located within the medical and the dental school, but open to the entire campus. In opening these TAL Centers, the IRMD looked to further the role of the University of Maryland as a prototype site under the IAIMS initiative.

Mission and Purpose. The TAL Center concept has as its foundation the idea that the health sciences must become increasingly receptive to recent technical developments in the transmission, storage, and dissemination of information. There can be little doubt that the traditional learning systems which support health care education today are suboptimal. Still dominated by the lecture format, the systems at the heart of traditional health education attempt to deliver large amounts of information in condensed time periods.

We acknowledge that the techniques of classroom and laboratory instruction have met the test of time. Our thesis is not that these models should be discarded as obsolete, but that they must be augmented by appropriate use of technology. Thus, the TAL Centers function not only as service delivery sites, providing access to commonly used information technologies, but also as demonstration centers, highlighting innovative new technologies and their applications in education. For example, the TAL Centers are currently developing new laser disk applications as well as showcasing existing laser disk programs.

In their first year of operation, the TAL Centers are providing a focal point for students at all levels, by encouraging the informed adoption of the new educational technology in as many ways as are appropriate to meet the needs of our undergraduate students, graduate students, faculty, researchers and staff users. The Centers are accomplishing this by assembling resources which illustrate the state of the art in technology assisted learning and facilitate the progress of learning systems research. In future years, the Centers will build upon this base by disseminating information to practitioners, academicians, and health care affiliated associations.

Development. After planning, the IRMD has continued to play the key role in establishing the TAL Centers. This involved assembling available resources within the health sciences center for use in the TAL Centers. To ensure success, the IRMD allocated a portion of its own operating budget to the Centers, to cover site preparation, equipment acquisition, and personnel. Through negotiating with the schools where the Centers were to be located, the IRMD was able to supplement its limited resources by acquiring space for the Centers. This process also served to validate that commitment from the faculty and administration would be continue once the Centers opened. It should be noted that the two schools making space available for the TAL Centers lacked such facilities, whereas other schools on campus, such as Pharmacy, Social Work, Nursing, and Law already had microcomputer labs of some description available for student use.

Site preparation of the first TAL Center, particularly in the area of space allocation and design, resulted in markedly different decisions in the preparation of the second Center. Each Center was quartered in a renovated facility, designed to be permanent. Early experience with the first Center showed it to be too small and stressed the importance of allowing for expansion. Design questions surfaced as the first Center attempted to take advantage of the state-of-the-art in ergonomics as well as the latest interior design techniques. Anticipated problems in wiring for connectivity to the mainframe as well as microcomputer peripherals were exacerbated by the Centers' multiple functionality. These functions required the accommodation of workstations in the same facility as videodisk equipment and large scale projection equipment. Resultingly, layout and lighting had to support two very different functions, as well as to create a setting conducive to learning.

The standard considerations and ergonomic features proved not always to be flexible enough for the multifunction facilities. In the first TAL Center, work surfaces and chairs appropriate to the individual workstation were found not to accommodate multiple users. Partitions between workstations occluded the view of the projection system, and lighting designed for microcomputer work detracted from demonstrations of the videodisk system. Fortunately, a certain amount of flexibility was built into the facility, through the acquisition of modular furniture. Modifications have been made on the first Center. Adaptations were factored into site preparation for the second Center, which fortunately was sited in an existing facility with a false floor, providing channels for electrical power and telecommunications lines and permitting future modification.

Acquisitions were made to provide the desired capabilities in the most cost effective mannner. When possible, software, courseware, and hardware available within the IRMD were reallocated to the TAL Centers. Substantial acquisitions were also made, totalling over twenty microcomputers and associated equipment. Where the workstations were to be used to access the campus computing network, the IRMD acquired less powerful microcomputers, which were then linked to the data communications system. Where the workstation was to be used in a standalone capacity, linkages were not installed and microcomputers were selected according to planned use, such as instruction in word processing or DOS. For graphics applications, more powerful machines were selected. Printers were shared between several workstations.

The two TAL Centers opened within the same calendar year, creating new demands on the IRMD'S Client Services Department which was responsible for staffing them. As the Centers moved into full operation, staff relationships were defined and structured. Keeping the Centers open, even in the evening hours, required a level of staffing not fully anticipated. Work study students were recruited to make extended hours possible. In addition to the staff directly responsible for providing services to users, a coordinator proved critical to the success of the Centers. This individual negotiates agreements for support, projects, talent, software, courseware, and hardware, as well as handles public relations. This function is absolutely essential, and we would urge that the position be created and filled at the start of the project.

During the first year of operation, the TAL Centers have organized and offered workshops emphasizing hands on skill development. These have generated visibility for the TAL center and provided high quality support for the faculty who must pioneer the new technology. Supplementing the IRMD's traditional course offerings in statistical packages (SAS, SPSS) and replacing earlier courses in electronic mail and mainframe based word processing, TAL Center offerings in the first six months of operation included short courses in the standard packages, such as basic introductions to microcomputing, word processing, and computer conferencing. Plans call for additional offerings in microcomputer database management packages and spreadsheets, as well as mainframe links to office automation products and eventually a mainframe data base management system.

Future Directions. In partnership with the Health Sciences Library, the IRMD sponsored an Information Technology Day in October 1986, which brought a number of vendors and state of the art applications to the campus for review. The TALCenters are currently building upon this exposure and becoming involved in efforts which will make the exhibited technologies and others available to the campus community, including:

- Videodisk applications
- Medically oriented data base utilization and interaction
- Authoring techniques for computer assisted learning
- Design of medical simulations

Making these and other technologies available in the TAL Centers can enhance independent learning for all students and establish the mechanisms for life long learning patterns for all health professionals.

As part of a related initiative, now that the TAL Centers are up and running, we are looking to bring a health informatician in courseware development and medical informatics onto the academic side of the IRMD. The TAL Centers will serve to support the informatics programs developed by providing appropriately equipped facilities.

We are also pursuing outside funding for the TAL Centers from both private and public sources to support its development activities. Reallocated IRMD funds can support only the acquisition of basic resources and the operation of classes. It is most important to secure the funding to allow the TAL Centers to respond to the rapid developments in information technology. It is only in this manner that the Centers can fulfill their function as demonstration centers for innovations in educational technologies.

To realize their role, the Centers will continue to serve as a focus for studies in the basic sciences and clinical sciences and utilize the latest technology assisted learning practices and resources available. Workshops are being planned which will encompass all areas of technology assisted learning, at both basic and advanced levels. Libraries of videodisks, interactive video, audiovisual, health sciences software, and computer based courseware are being established by the Centers in cooperation with the Health Sciences Library. Eventually, they will be made available online, as will access to national data bases, now being planned for under a separate initiative.

Clearly the informatics initiative necessitates an evolving relationship between the IRMD and the Health Sciences Library. We two organizations must work together to offer this campus and its professional schools truly integrated information resources management. To this end, we have forged a merger between us, and share a single policy committee made up of the deans of the schools and senior level officers on campus. Our TAL Centers and Client Services areas work in cooperation with the Library's Information Management Education Department to provide the highest level of service to the campus community. Indeed, the IRMD hopes to assist the Library in establishing a TAL Center within the Library itself.

Over the past year, we have come farther than we would have imagined when we first wrestled with blueprints and budgets. We have translated the TAL Center to concept into a real and dynamic force within the University of Maryland Campus for the Professions. The Centers' visibility will strengthen our efforts as we enlist the continued commitment of campus policy makers to state-of-the-art information technology and to the resources necessary for its support. The mission of this campus and of others deserves no less.

Footnotes

1 Thomas E. Piemme and Marion J. Ball, Executive Management of Computer Resources in the Academic Health Center (Washington, D.C.: Association of Academic Health Centers, 1984), position paper.

2 P. R. Manning, "Continuing Education: The Next Step," Journal of the American Medical Association, 249 (1983), 1042-1045.

3 Panel on the General Professional Education of the Physician and College Preparation for Medicine, Physicians for the Twenty-First Century: The GPEP Report (Washington, D.C.: Association of American Medical Colleges, 1984).

4 T.M. Jenkins, M.J. Ball and B.M. Bruns, "The State of the Art in Technology Assisted Learning," AAMSI Congress Proceedings, 1983, The Second Annual Congress on Medical Informatics, San Francisco, California, May 2-4, 1983.

5 Manning, pp. 1042-1045.

6 Piemme and Ball, pp. 24-25.

7 Piemme and Ball, p. 18.

8 Nina Matheson and John Cooper, "Academic Information in the Academic Health Sciences Center. Roles for the Library in Information Management," Journal of Medical Education, 57, No. 10, Part II (1982).

9 "Planning for Integrated Academic Information Management Systems," Proceedings of a Symposium sponsored by the National Library of Medicine, Bethesda, Maryland, October 17, 1984.

PLANNING FOR MICROCOMPUTER INTEGRATION: MANAGEMENT DIRECTION

Linda Heidel

Stanford University
Information Technology Services
Medical Information Services
Stanford, California 94305

The implementation of microcomputers in administrative settings continues to expand exponentially. Key to control of this growth is management direction and user support programs that address the effective use of microcomputer technology and emphasize the importance of integration with other complementary computing resources. As the installed base of workstations expands, and as technology advances, user support programs must be responsive to an expanding client base, increased information demands, and hardware/software innovations. In addition, since users develop not only personal applications, but also operational systems that benefit the organization as a whole, management direction needs to be provided to ensure that users have adequate access to plans, documentation, and training.

This paper will review a program that has achieved success in providing support to administrative clients within a large University Medical Center. It will discuss the origin and evolution of management programs that have proven instrumental in guiding the implementation of a cost-effective microcomputer workstation environment in a complex environment.

MICROCOMPUTER INTEGRATION: MANAGEMENT DIRECTION

ENVIRONMENT

Stanford University Medical Center

Medical Centers are typically very complex environments, generally very large, requiring 24 hour/7 day a week staffing and system availability. At Stanford, the medical center environment includes the School of Medicine, Stanford University Hospital, and the Faculty Practice Program which provides care through a system of clinics. These units are geographically interconnected and medical center personnel often have responsibilities in all three areas, yet the information systems, policies, and financial processes are quite different.

In spite of these differences, however, each unit is experiencing the same phenomonon: the rapid growth of microcomputers and the need for their integration into the information systems environment. This trend has been accelerated by three key factors:

* cost reductions have made the technology more accessible

* easy-to-use software has become widely available

* business pressures have demanded the rapid and effective use of technology

As a consequence, Stanford has experienced an expansion in the number of departments acquiring microcomputers to develop and access tools that address their business needs. In addition, there has been a demand by users for management programs that directly support and encourage the effective use of these systems and associated software thereby promoting better integration into the business environment.

Historically, the acquisition of new technology evolves through four predictable stages of growth:

Phase I:	Initiation (early experimental use)
Phase II:	Contagion (rapid expansion)
Phase III:	Control (management direction)
Phase IV:	Integration (technology effectively integrated)

Stanford University Medical Center has progressed through the first two of these phases and has now entered the third phase. There are now approximately 475 microcomputers installed in the Medical Center exclusively for administrative use, nearly double the amount last year. IBM microcomputers clearly dominate the installation profile, representing 83% of the installed base. Projected growth in the coming year is 18%. Therefore, it is imperitive that we continue to determine how we can best manage this growth without deterring the important benefits that end user computing has to offer (such as timely information, reduced central costs, increased departmental control, etc.). We believe that the keys to successful management direction are to put the appropriate control mechanisms in place early and to implement support programs that have proven to be successful in distributed computing environments.

Medical Information Services Microcomputer Program- Origin and Staffing

The Associate Dean for Administration in the School of Medicine realized that a coordinated program and plan would be necessary if the Medical Center was to meet its information management goals. As a result, he contracted with the University Data Center, Information Technology Services (ITS), to direct and develop support programs that would encourage the use of compatible systems designed to integrate well with the existing mainframe environment and insure the realization of organizational goals. It was thought that the Data Center staff would have an awareness of the existing mainframe environment and an understanding of how departments would use these systems. In addition, the Stanford University Data Center had taken a very supportive posture regarding microcomputer technology and had developed training programs and mainframe tools which promoted cooperative processing. The contract with the Data Center, which is reviewed and renegotiated annually, has been in effect since January of 1983 and has grown to include support for the Hospital and Clinics. (These functions were formerly performed by the Management Engineering department in the Hospital.) Current staffing includes one Program Manager, one senior consultant, and five part time consultants.

MANAGEMENT DIRECTION

Our strategy for planning for microcomputer integration includes the following:

- senior management endorsement of the program
- establishment of an Administrative Systems Committee with representives from department management, the University Data Center, and the Dean's staff
- publication of general system guidelines to aid in the procurement and development process including identification of "supported products" and University computing standards
- development of an automation plan focusing on administrative computing "tools" including:
    - standardization and implementation of financial templates
    - mechanism for processing selected University forms on-line
    - identification of communication pathways and alternatives
- development of an End User Support Program which provides consulting and training for administrative staff
- implementation of monitoring tools such as an annual departmental survey and consulting data base
- examination of the information flows within departments

Administrative Systems Committee

One of the more important elements in this strategy was senior management endorsement which was reflected by the establishment of an Administrative Systems Committee (ASC). Initiated in 1983, the Committee, consisting of twelve representatives appointed by senior management, meet monthly and represent a broad spectrum of interests in the Medical Center. The Committee has the following charter:

- develop guidelines for system procurement

- develop a strategic automation plan

Guidelines for System Procurement

In tackling the first charge, the ASC established two major goals: implement systems which are compatible with the information system environment and standards at Stanford and provide support programs targeted to specific products. It was anticipated that managers would not respond positively to strict rules governing the equipment they could purchase. The guidelines stressed the importance of sharing information electronically, being compatible with the University and Hospital mainframes (IBM 3084 and 3083), and moving toward a common communication goal. At the same time, the University was finalizing agreements with IBM, HP, and Apple for hardware discounts on microcomputers and associated products. At the conclusion of the negotiations, a list of supported products was developed and published. Following in-depth evaluations, software products were also selected for the supported list including:

* Multimate for word processing
* Lotus 123 for spreadsheet management
* Dataease for local data base development

To address the need for communication with the Data Center mainframe, a communications package was developed by the Data Center which permitted terminal emulation and file transfer between the IBM mainframe and microcomputers (including IBM, IBM compatible, and Apple Macintosh).

Use of supported products benefit departments since they can take advantage of consulting support and training classes. The list is under continual revision by a University committee as new products enter the market. Department Managers quickly saw the advantage of selecting supported products, and accepted the committee guidelines.

Development of Strategic Automation Plan

The next step taken by the ASC involved the development of a strategic automation plan which focused on issues of compatibility, end user support, software tools such as financial templates and on-line forms. The purpose of the Plan is to:

- ensure that systems developed within the Medical Center adhere to University administrative system standards and are compatible with the existing computing environment

- guide the development of administrative computing "tools", such as templates and on-line forms, and encourage electronic communication

- ensure that the existing and planned investment in equipment is protected via training and support

Since the speed of change in this technology has been so rapid, the Committee decided to focus on the planning process and the ability to manage change rather than developing a static, long range plan.

IMPLEMENTATION ISSUES

The Administrative Systems Committee recognized the need for a more efficient means of implementing software tools, providing training, and establishing end user support programs. As such, they identified several areas where structured requirements and programs were necessary.

Financial Templates

As departments develop their own applications, one of the likely consequences is redundant effort and inefficiency. In the Medical School, for example, there are 20 individual departments, each performing similar administrative functions such as budgeting and management reporting. It is clear that these functions would adapt very well to standardization via templates, leading to more data consistency and better understanding of the financial picture within the School. "Templates" may be defined as software "tools" that primarily take the form of spreadsheet-based (Lotus 123) models designed to facilitate financial activities within a department. If the functionality of the model can be applied across departments, it then becomes a potential Medical Center template. Stanford is in the early stages of implementing this template process. Current templates include those used for the faculty salary setting process and long range financial forecast.

Development: Any departmental staff member may develop a template and associated documentation and submit it to the Administrative Systems Committee for review. Standards which clearly identify the necessary characteristics of templates will be developed by the ASC.

Review: The Administrative Systems Committee is responsible for ensuring that the templates are reviewed by appropriate specialists such as the Controller's staff for financial templates, Personnel staff for salary setting templates, etc., before they are released. In addition, other staff may become involved as necessary. The review includes not only an assessment of the accuracy and efficiency of the model, but also the completeness and clearness of the documentation as well.

Approval: Final approval is the responsibility of senior Medical Center management based upon the recommendation of the ASC. Once the volume justifies it, a master file of approved templates and associated descriptions will be maintained on-line. Training will be provided in the Medical Center training facility as part of the End User Support Program.

On-Line Forms

An "on-line form" may be defined as a mainframe-based software form that is usually associated with a Stanford University requisition number and signature hierarchy. Integral to its acceptance and use is the development of an electronic signature methodology and corresponding level of security. Since most of the forms that are candidates for computerization involve other departments within the University, the University Data Center (ITS) will be responsible for their development.

> Prioritization: Working with central University offices, ITS will develop a list of potential forms and assign development priorities based upon anticipated productivity gains, dependency upon other systems, ease of development, and required security.
>
> Development: ITS will be responsible for development and maintenance
>
> Implementation: ITS and the office ultimately responsible for the information will co-implement the forms as they become available.

Current forms include a faculty appointment form, Stores ordering, check requests, and requisitions.

Planning for Medical Center Electronic Communication

With the development of new administrative tools, the Medical Center must plan for the capability to communicate electronically. As a recognition of its importance, a new position was established for a communications planner. This individual will be responsible for examining current capabilities and recommending future direction. This will be a very challenging responsibility since the Medical Center topology includes Xerox local area networks, 3COM local area networks, data communications via a telephone switch, and gateways to the academic network SUnet. In terms of administrative data, one of the greatest challenges is protecting the integrity and security of administrative data that is accessible via a network.

END USER SUPPORT PROGRAM

The goal of the End User Support Program is to provide centralized support while developing and implementing distributed support programs. In many Schools at Stanford, departments are implementing microcomputers at a pace that outdistances the development of coordinated support activities. As a result, there is some loss of productivity as users duplicate efforts already in place or under development in other departments. It is important to develop an effective End User Support Program to help staff members become involved in "do-it-yourself" computing through consulting, training, and data coordination.

We have implemented a distributed support program which includes:

- the establishment of a Medical Center Workstation Resource Center
- development of a Regional Specialist Program

Workstation Resource Center

Experience indicates that end users continue to need assistance with selecting and using hardware and software tools. A central Workstation Resource Center provides a cost-effective environment for these services. Services include:

- system purchase advice
- installation and support for new and existing hardware and software
- education, including course and materials development
- consulting- assistance with questions, problems, design, and access to data
- reference library
- product evaluation center
- workstation laboratory

Regional Specialist Program

The Regional Specialist Program, also termed the "local expert" group, is the second important component of the End User Support Program. Regional Specialists are those individuals who, through experience and initiative, have effectively assimilated and adapted to the technology. These specialists become the "keystone" for distributed support. They ensure communication between professional users and the support organization, reduce duplication of effort, and supply the necessary resource for user support. Specifically, they:

* provide effective on the job training of new users
* provide a point of control for auditing and security issues
* understand the "business" of the department
* in some cases, develop applications for departmental staff
* provide an essential communications channel to the central support organization

Direct involvement of user department personnel in the Regional Specialist Program manifests the department's commitment to end user computing. The Regional Specialist Program provides cultivation of local experts and coordination of User Group sessions. The User Group sessions constitute informal training opportunities and provide a forum for sharing helpful hints and demonstrating user-developed procedures and applications.

PLANNING AND EVALUATION TOOLS

In order to monitor the effectiveness of the End User Support Program and remain aware of the needs of the institution, two management tools have successfully been employed:

1. annual survey of department managers

2. consulting data base

Annual Survey

Each year, a survey of department managers has been conducted. Surveys are conducted in January for the Hospital and in August for the Medical School. Nearly 100 interviews are conducted in person, each requiring approximately 45 minutes to complete. Data from the survey has resulted in several benefits including:

- an assessment of the direction of automation and conformance to the Plan

- a hardware/software inventory

- a reference document for consultants, Regional Specialists, and department managers

- an indication of the level of satisfaction with support received

- identification of new services

- identification of problem areas where additional training is needed

This year, we were able to compare our findings with those of the previous year. Some of the more significant findings indicate that:

- The number of microcomputers has doubled in the past year, from 180 in 85/86 to 360 in 86/87. This represents an investment of over $1 million in microcomputers alone.

- IBM products comprise 81.1% of the installed microcomputers.

- There has been a consolidation of software selection around University supported software, with 65% of the departments using Multimate for word processing (29% increase), 84% using Lotus for spreadsheet management (44% increase), and 42% using Dataease for data base development (100% increase).

- There was a 77% increase in the number of data lines installed to the Data Center (37% of the departments indicate that they use mainframe systems, and 27% indicate that they use electronic mail).

* There will be an 18% increase in the number of microcomputers installed in the next year. IBM will be selected for 92% of these purchases. Projecting out to 1990, it is estimated that over 700 workstations will be in place for administrative computing.

* 75% of the departments utilize microcomputer services offered by Medical Information Services (MIS), a unit of ITS, and rated the support as excellent to highly satisfactory.

* There is unanimous agreement that Users Groups have been of value in the Medical School. In addition, managers agree that a Medical School training facility would help improve staff computer literacy and afford a curriculum responsive to School plans. More training is desired in basic DOS commands and advanced software features.

The surveys have been greatly appreciated by management. Although the process is very resource intensive, the results are extremely valuable to the institution. Future surveys may be conducted on-line, with a smaller subset selected for one-on-one interviews.

Consulting Data Base

In order to track the effectiveness of resource utilization, a consulting data base was developed by ITS using Dataease. Consults or client encounters, including telephone calls for assistance and on-site support, are recorded and entered into the data base. Although this may appear to involve a considerable effort, the result has been management reports that isolate specific problem areas (such as using the HP Laserjet printer) that allow the development of workshops or the application of resources for commonly reported problems. In addition, department managers can review, via periodic reports, the type of support the department is receiving, who is using the service, and what problems the staff is experiencing.

SUMMARY

Where are we now? Recently, ITS was asked to independently examine the flow of data within the School in order to improve the management of information. This resulted in the generation of "data maps" which identify the primary sources and destinations of information, the format of that information, and how often it is updated. These data maps are similar to data flow diagrams used in the process of software development. Clearly, some of these areas can be assisted via financial templates and on-line forms. The changing administrative environment may force fundamental changes in the organizational structure. This year we plan to make significant progress toward maximizing awareness of central administrative systems, locally developed applications, and decentralized support programs.

The Medical Center has also increased its independence, now that it is more comfortable with the technology, and relies less on central support. As a result, senior management is developing an organizational structure which will deal with both academic and administrative computing in the School. It will maintain a liasion with the Data Center so as to minimize the necessity to provide redundant resources in the Medical Center.

Stanford University Medical Center is in the third phase of technology acquisition and is rapidly approaching the fourth phase: Integration. We anticipate that this phase will require a maturation of our support organizations, but since we have predicated our direction upon feedback from our planning process and our ability to manage change rather than predict technological advances, we believe we are well positioned for the future.

Implementation
# of a
User-Friendly University Recruitment and Admissions System
in a
Multi-Campus Environment

by

Patricia Hassett
Clelia Lobosco
Ruth Spitz
Chris Barbariantz

Fairleigh Dickinson University
Rutherford
New Jersey

and

Michael Fox

Software Research Northwest, Inc.
Seattle
Washington

In search of a user-friendly recruitment and admissions system for a multi-campus environment, Fairleigh Dickinson University (FDU) chose the Hewlett-Packard 3000 and a software package developed by Software Research Northwest. Installation of both hardware and software was accomplished in a relatively short period of time with impressive results. This paper will address the selection, installation and implementation of the system. As with any system implementation there are obstacles to deal with but in this case, an outstanding product combined with unbridled enthusiasm produced a viable and productive admissions information system.

Selection of System Software

The Iowan cornfields seem the unlikeliest setting for a first glimpse of the recruitment and admissions system that became the integral component of Fairleigh Dickinson University's (FDU) Admissions Information System. Developed by Software Research Northwest (SRN), the system supports all the functions of admissions from pre-inquiry to post-admissions follow-up.

Last year, FDU was faced with a dilemma familiar to many institutions, declining enrollments coupled with increasing competition for the available college-bound high school student. A number of recruitment and admissions systems were considered for installation at FDU -- software for the IBM System 36, the Wang VS 85 and the Hewlett-Packard (HP) 3000. (See Chart I on page 8).

In a multi-campus environment with a centralized admissions office, the need for a system providing prompt and efficient processing of student inquiries and applications, as well as reporting and personalized letter writing capabilities was evident. Additionally, interface of any admissions system chosen must ultimately link to the University's mainframe, an IBM 4381 on which resides registration and bursarial systems.

Clearly, it would appear that acquisition of software running on an IBM would ensure easy interface with the University's mainframe. However, the available software was much to be desired. In the case of the Wang compatible software, any package purchased would need considerable programming modification for adaptation of proprietory school admissions software to meet the needs at FDU. Time was of the essence -- it was August 1985 and a system had to be operational for Fall 1986. The ultimate selection therefore was the SRN package which runs on the HP 3000.

Identification and Installation of Hardware

The question of hardware identification became the next key issue. Equipment considerations included: to purchase refurbished or brand new; what kind of printers; selection of terminals and tape drives; how many should be bought or leased; how were telecommunications to be set up between campuses; and what type of modems? Additionally, the network of campus Admissions' offices is not conveniently situated in one office building, but is interspersed in a mansion and once stately residences in three different cities. After selection of the campus location for University Admissions, a site for the central processing unit (CPU) had to be chosen -- the choices -- an attic, a basement and a porch. HP personnel inspected the possibilities with the basement winning out. But the fun had just begun! Carpeting was torn out to make way for tiling and a raised floor was installed to protect equipment against possible flood damage. Environmental considerations such as air conditioning and relative humidity were addressed. Installation of a 100 Amp panel with emergency shunt trip breaker and nine direct lines were required. And finally, measurements were taken to ensure that computer equipment would clear doorways while movers could proceed down several tenuous stairs to the basement level.

The day for delivery had arrived when a 60 foot electronic padded van pulled up in front of the admissions house and out stepped the movers -- a husband and wife team. This delivery was to be far from ordinary. After unloading all the equipment while an ever present threat of rain existed, the first item, the CPU, was wheeled across the backyard only to sink into the damp grass. Once this obstacle was overcome, it was discovered that the CPU which had a depth of 34 inches would definitely not fit through a doorway measuring 32 inches. A frantic call was made to the HP salesperson who in turn called the district manager -- the instructions were not to accept delivery of equipment. Needless to say, we were not about to send back well over $100,000 worth of equipment when we expected to be in operation by January 1986. After further "discussion", within 15 minutes two HP representatives arrived in an ominous looking staff car. They rolled up their shirt sleeves, loosened their ties and proceeded to lift the 1,240 pound CPU on its side and slowly ease it down the stairs. Barely missing the low ceiling it eventually found its home in our basement.

The Fairleigh Dickinson University Recruitment and Admissions System runs on a refurbished Hewlett Packard series 3000 model 48, better known as a System 48. Our System 48 contains 3 megabytes (MB) of main memory, allowing for rapid report generation via use of a technique known as disc caching. This feature loads the most often used files into main memory thereby cutting down on input/output time needed to read disc based files.

Disc space is available on four Model 7925 drives each having a storage capacity of 120 MB. Each drive has a removable disc pack. Our combined disc space, totalling nearly 500 MB, allows for a considerable on-line student admissions system spread out among 37 master, detail and automatic datasets.

The Student Admissions Module (SAM) is comprised of three databases, two of which are fully backed up every day using magnetic tape and a 1600 BPI tape drive. In addition, the drive is used for the loading of tapes received from agencies such as the Educational Testing Service. Student test and biographical information is read from tape and is updated to our on-line system. Student Search Tapes may also be downloaded into our student search database.

The remainder of our hardware inventory includes a 400 line-per-minute system printer used for all of our report printing. On each campus there is a 200 character-per-second printer for that report that just can't wait overnight. All of our letter-writing is done on two 7 page-per-minute laserjet printers. Currently, plans are being made to upgrade these printers to accommodate the growing need for different types and greater quantities of personalized correspondence.

The HP communicates with the other campuses using Paradyne 9600 baud modems and HP multiplexers. These enable us to use one telephone line per four terminals with no noticeable decrease in transmission speed. Terminal inventory at the present stands at 15, utilizing the slim-design HP2392A and HP150II CRT equipment.

One sub-system of the HP 3000 we plan to begin using is Remote Job Entry (RJE), which enables the System 48 to emulate an IBM 3780 Remote Work

Station. A student record, once created for admissions or recruitment purposes must then be transferred to the Student Information System (SIS) on the IBM in order for a registration and bursarial record to be created. The reverse is also true. A student record created on the SIS must be transferred from the IBM back to the HP. This would occur in the case of a direct admit; a student who wishes to apply and register on the spot. Currently tapes are used to exchange data from the HP to the IBM only. Once the reverse cycle software is completed and the RJE is fully operational, the HP and the IBM will be constantly updating each other.

Additional features of the HP System 48 include the ability to handle up to 152 users. Our service contract ensures a 4 hour hardware and a 1 hour software problem response time. Our preventive support feature allows the CPU to diagnose itself for potential hardware problems, and then calls the report in to the HP Response Center in Atlanta. All in all, the System 48 is a very user-friendly system that can assure users of virtually trouble-free operation.

Installation of the Undergraduate Admissions Component

The Student Admissions Module (SAM) installed at FDU is a stand-alone component of the Integrated Records Information System (IRIS). As such, it may serve as the front end component of a fully integrated IRIS installation, beginning with admissions and running through to financial aid, registration, student records, academic advising, housing, student affairs and culminating with alumni and development. Or, as FDU demonstrates, SAM may function on a stand alone basis, with batch interfaces to the existing SIS resident on the University's IBM 4381.

SAM was designed to handle complete admission processing, with heavy emphasis on the unique marketing needs of higher education. While most admission systems are built around application processing and tracking, very few support every aspect of admissions' marketing, from direct mail contacts with students during the sophomore or junior year of high school right through to orientation and initial registration at the institution.

SAM builds a single record for each prospective student and, once application materials arrive, that record is expanded as the student moves closer to registration. Data is never rekeyed and admissions may segment its prospects and applicants into an unlimited number of unique groupings. SAM treats each user-defined group as unique and FDU has the ability to construct completely different processes and communications for freshmen, transfer students, graduate students and any other market segment it cares to approach.

SAM is built around four interlocking parts:

> BOX - stores all name and address data; in addition, BOX includes full letter generation capabilities without the need for downloading to micros or engaging in mail merge functions.
>
> STS - stores all data off tapes received from testing agencies (ATP, ACT, GMAT, GRE, SSS, etc.).
>
> SAM - stores all data pertaining to prospects, applicants and admitted students.
>
> UCX - controls all of the data values used throughout the system; specially formatted screens permit users to define and modify virtually everything in the system, from major codes to screen formats without having to alter source code.

Every portion of the data base is accessible from a powerful, easy-to-use report writer, which may be used for printed reports and analyses. In addition, the report writer may call the letter generating capabilities of BOX, thereby permitting users to initiate very personal correspondence with any group of prospective students and/or applicants.

As mentioned earlier, data is never rekeyed. All data codes are stored in user-defined tables within the UCX. These tables control each stage of the marketing process by interactively automatically prompting correspondence, reminders, reports, summary comparative data and permissible changes to individual records.

There are also several types of data screens depending on the information being accessed. There is an inquiry screen, five different applicant screens, a biographic screen and a letter screen to show the history of mailings. These screens are designed to follow information gathered from our application for ease in data entry.

A student's progress within the system is logged by changes in a student's status. For example, when a student is entered as an inquiry, the student's status is "IQ"; once an application is received the status changes to "AP"; and is continuously updated through the status of "RG" for registered.

Once a file is complete and a student's application is ready for review, the system has an auto admit routine which takes over. Based upon predetermined criteria programmed into the software, when a student's rank, SAT scores, etc. are entered, the student's status will automatically change and inform us whether the student is eligible for admission or needs to be referred to a committee for further consideration. This is a unique feature of the software which was implemented to expedite the review of non-marginal candidates.

Staff training required that everyone get acquainted with new hardware as well as new software. In order to make this transition as simple as possible, the coding of information was kept the same as that currently being used on our IBM student file. After a general introduction to the concept behind the SRN software, a hands on training period began with everyone required to spend time inputting information on students already accepted. As of the Spring 1987 semester, we have made the total transition of data entry on all inquiries for undergraduate and graduate; and the application processing for full-time and part-time students.

With the adoption of our own computer system, came the capability to access and summarize data on our applicants stored in the data base. The concept behind reporting has 4 steps:

1. The user selects the criteria pool and report format. For example, information can be summarized on academics, advertising, test totals, geographics, college and majors.

2. The general interface program determines the optimum path for data retrieval.

3. The general abstract prepares a sort file for just the pool of people requested in the reports.

4. The format program produces the desired printed report or several reports containing different summary data on the same pool of students.

A final component of SAM is the Online Totals Display or TAD. TAD displays to the terminal screen, summary history and comparative data relative to a specific semester, student population, etc. This information can be stored on a monthly, weekly or daily basis.

Conclusion

In reviewing our selection, (See System Profile on page 9) we feel that our decision was one well made. Since the installation and implementation of the Hewlett-Packard equipment and the SRN software, we have been able to accomplish even more than we had anticipated. In addition to processing applications for undergraduate and graduate admissions and tracking inquiries through admissions and registration - we are able to generate a number of sophisticated reports; most notably, our new advertising reports which help to measure the effectiveness of the various forms of advertising in which we engage.

Chart I

OPTIONS CONSIDERED FOR SELECTION of FAIRLEIGH DICKINSON UNIVERSITY'S RECRUITMENT and ADMISSIONS SYSTEM

Hardware	Software
WANG VS 85 - 2 MB main memory; 64 users (maximum); field upgradeable to VS 100	**Clifton Computer Software** - prospect/admissions system to be developed for FDU needs; current software was for use in proprietory school environment
IBM System 36 - 1.75 MB main memory; 45 devices (maximum)	**College and University Administrative Software System developed for Champlain College** - integrated modular design system supporting both academic and administrative functions; most functions stand alone
HP 3000 - 3 MB main memory; 152 users (maximum); upgradeable to other models within the 3000 family; refurbished	**Integrated Records Information System (IRIS) of Software Research Northwest (SRN)** - Student Admissions Module (SAM) is a stand-alone component of IRIS which tracks students from the point of inquiry through registration

PROFILE OF THE
FAIRLEIGH DICKINSON UNIVERSITY
ADMISSIONS INFORMATION SYSTEM

Hardware

HP 3000 Series 48 (refurbished) with 3MB of main memory, 480 MB of disc storage, 1600 BPI magnetic tape drive, two laser printers, one 400 LPM system printer, two 160 CPS letter quality printers, three 200 CPS printers, one PC, and 15 terminals.

Software

Remote Job Entry, Cobol II Compiler, HP Word

Student Admissions Module (SAM) - designed to support all the functions of an admissions operation ranging from pre-inquiry marketing activities to post-admissions follow-up. SAM is built around a multifaceted data base that is linked to:

1) user defined UCX (Universal Code Extension) tables
2) flexible, easy-to-use data entry screens
3) a powerful report generator
4) an interactive letter writer

SAM's data base is comprised of six files:

1) Prospect/Applicant File: An individual master record is built for each prospective student with only essential data entered at the inquiry stage. When the student applies to FDU this same record expands to retain the data necessary to make an admissions decision. As students progress from one stage to another, their statuses change, allowing for the control, sorting and definition of multiple populations.

2) Name Search File: A KSAM (Keyed Sequential Access Method)

file allowing quick identification of students in the data base through a name search methodology.

3) STS File: The Student Tape System data base stores student information from the following tapes - Student Search, SAT, ACT, ATP, GMAT, GRE, GMASS and NJ Distinguished Scholars.

4) ETS School Code File: Stores the ID numbers, names and addresses of all high schools, colleges and universities in the US as well as many foreign institutions.

5) UCX File: Stores and maintains all definitions and values assigned to data elements in SAM.

6) LTG/Letter File: Contains letter text and letters used in corresponding with students, parents and schools during the admission process.

Special Features

1) The Series 48 may support up to 152 users
2) Communication is currently linked to 5 remote locations
3) Future IBM 2780/3780 emulation
4) Tele-support to HP Response Center in Atlanta
5) Capable of storing one million student records
6) Automatic admit function on SAM software

University Admissions Information Systems
December 1986

PROFILE OF THE
FAIRLEIGH DICKINSON UNIVERSITY
ADMISSIONS INFORMATION SYSTEM

Hardware

HP 3000 Series 48 (refurbished) with 3 MB of main memory, 480 MB of disc storage, 1600 BPI magnetic tape drive, two laser printers, one 400 LPM system printer, two 160 CPS letter quality printers, three 200 CPS printers, one PC, and 15 terminals.

Software

Remote Job Entry, Cobol II Compiler, HP Word

Student Admissions Module (SAM) - designed to support all the functions of an admissions operation ranging from pre-inquiry marketing activities to post-admissions follow-up. SAM is built around a multifacited data base that is linked to:

1) user defined UCX (Universal Code Extension) tables
2) flexible, easy-to-use data entry screens
3) a powerful report generator
4) an interactive letter writer

SAM's data base is comprised of six files:

1) Prospect/Applicant File: An individual master record is built for each prospective student with only essential data entered at the inquiry stage. When the student applies to FDU this same record expands to retain the data necessary to make an admissions decision. As students progress from one stage to another, their statuses change, allowing for the control, sorting and definition of multiple populations.

2) Name Search File: A KSAM (Keyed Sequential Access Method) file allowing quick identification of students in the data base through a name search methodology.

3) STS File: The Student Tape System data base stores student information from the following tapes - Student Search, GMAT, ACT, ATP, GMAT, GRE, GMASS and NJ Distinguished Scholars.

4) ETS School Code File: Stores the ID numbers, names and addresses of all high schools, colleges and universities in the US as well as many foreign institutions.

5) UCX File: Stores and maintains all definitions and values assigned to data elements in SAM.

6) LTG/Letter File: Contains letter text and letters used in corresponding with students, parents and schools during the admission process.

Special Features

1) The Series 48 may support up to 152 users
2) Communication is currently linked to 5 remote locations
3) Future IBM 2780/3780 emulation
4) Tele-support to HP Response Center in Atlanta
5) Capable of storing one million student records
6) Automatic admit function on SAM software

For additional information:

Michael Fox	Patricia Hassett	Clella Lobosco	Ruth Spitz
V.P. for Mktg./SRN, Inc.	Asst. V.P. for Enrollment Mgt.	Asst. Systems Mgr.	Univ. Admissions Mgr.
206-567-5194	201-692-9735	201-460-5229	201-460-5293

```
SAM35 - Individual Composite Format               Fairleigh Dickinson University

Dickinson, Fairleigh Z.              ATTR: M          ID: 111111112       Fairleigh Z. Dickinson          ATTR: M
      609 Adams Street               CNTY: HD      NICKN: Lee             P.O. Box 100                    CNTY: HD
      Hoboken NJ 07030               AREA: NJ0     ASSOC: ANNNNNNNNN      Hoboken NJ 07030                AREA: NJ0
                                     TOWN: 09276   XPIRE: 10/15/87

      (201) 333-3434                                                      (201) 333-3535
_____________________________________________________< biographic >_______________________________________________

      SSN: 111-11-1112   ETH: White/Non Hispanic        VISA: US Citizen           MRTL: Single                 VETN: N
    BIRTH: 06/06/66      RES: NJ Resident               DATE:                      RLGN:                        HDCP: N
      SEX: M             CIT: United States                                        RLTV: Father Alumni
                                                                                                       TY  AL ST ED XX
                    EMPLOYER:                                 PRNT1:
                       TITLE:                                 PRNT2:
                       PHONE:
_____________________________________________________<  inquiry  >_______________________________________________

      1ST CHOICE                     2ND CHOICE
CAMP: Rutherford                                                STAT: AD Admitted          TERM: FA87  FILE LOC: R
COLL: Samuel J. Silberman College of                            DATE: 11/14/86            LEVEL: T      LOG IN :
TYPE: Undergraduate                                             HIST: APFCEAAD             TIME: FT     LOG OUT:
MAJR: Hotel, Restaurant & Tourism                               STAF: Marge Cooke           AID: PS
DEGR: Bachelor of Science
SPCL:                                                         SCHOOL: Bergen CC

INQUIRE     TY1: RF   INQ1: Referral from Friend           ACTIV1: Tennis                        6:
DATE:       TY2: VS   INQ2: Open House                     ACTIV2: Football                      7:
            TY3: MA   INQ3: "About Quality"                ACTIV3: Yearbook                      8:
11/14/86    TY4:      INQ4:                                ACTIV4: National Honor Society        9:
            TY5:      INQ5:                                ACTIV5:                              10:
_____________________________________________________< applicant >_______________________________________________

                                                      Dates:                                                   Defs:
APP-TYPE: RA      HOUSING: Dorm                         APPLY:11/14/86  HS: 310602 Hudson Catholic Regional HS ENGL: 0
EVALUATN:           VISIT:                           COMPLETE:11/14/86       GPA:                              LANG: 0
DECISION:       INTV CODE: No Interview Required        ADMIT:11/14/86   GPA APP:          PERCENT: 04         MATH: 0
REJ REAS:       INTV DATE:                            DEPOSIT:           GPA LTR:        RANK/SIZE: 9/188      NATS: 0
STANDING: 82      ADVISOR:                             CANCEL:           GPA PCT: 93     GRAD DATE: 06/85      SOCS: 0
_____________________________________________________<  college  >_______________________________________________

  ETS: 2032   Bergen CC
       DEGR: AA    YR: 87   GPA CUM: 3.780       DEGR:      YR:      GPA CUM:              DEGR:      YR:      GPA CUM:
                   CR:   64 GPA MAJ:                        CR:      GPA MAJ:                         CR:      GPA MAJ:
______________________< tests >_______________________< comments >_______________________________________________
                                 |                    |
CODE  SCORE  DATE  TYPE | CODE  SCORE  DATE  TYPE     | KEYS:  1. INTERVIEW   2. ATHLETE    3.          4.          5.
                        |                             | COMMENTS:
SATV   650   11/84  U   |                             |     Excellent Recommendations
SATM   670   11/84  U   |                             |     Scholar Athlete
SATC  1320   11/84  U   |                             |
                        |                             |
                        |                             |     University Admissions Information Systems - December 1986
                        |                             |
```

411

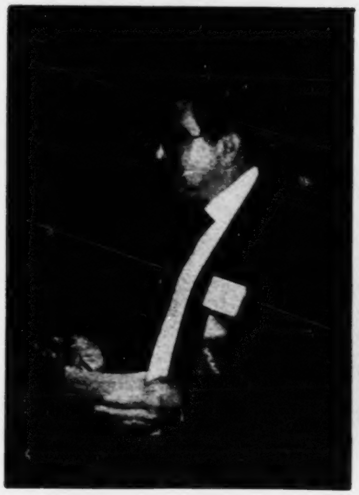
Track VI

Microcomputer Issues and Applications

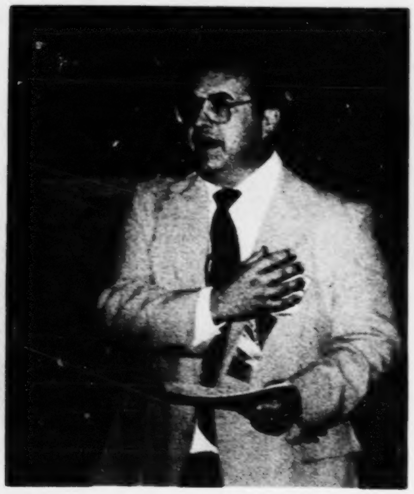
The growth of microcomputers on our campuses has raised issues, solved latent computer needs, and changed our computing philosophies. Papers in this track discuss micro policies, problems, and experiences, and analyze solutions to the integration of the micro as an effective partner with other computing resources.

Coordinator:
Jim Hill
Dallas County Community College District

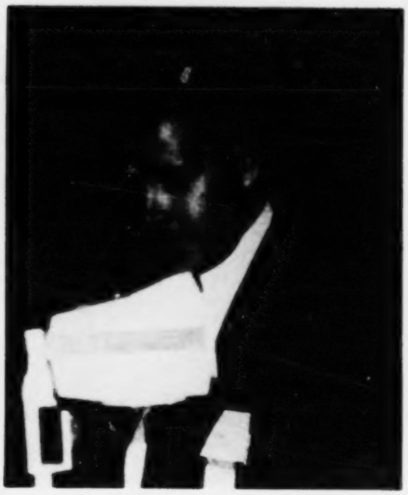
Thomas Maggiacomo
Bentley College



John True
San Francisco State University



James Vanderpool
University of Colorado



THE ACQUISITION AND USE OF MICROCOMPUTERS ON COLLEGE CAMPUSES

December, 1986

Gary Devine
Wayne Donald
Jim Vanderpool
Michael Zastrocky

NCHEMS Management Services, Inc.
Boulder, Colorado

Abstract

Long before the advent of the computer age, Thomas Carlyle observed "Nothing is more terrible than activity without insight." How relevant his words remain today.

As the race to "computerize" the nation's campuses continues, the risks and rewards of such endeavors loom increasingly larger. The chairman of one computer sciences department aptly catches the paradox in noting that his school "wants to be out in front in understanding what the personal computer means for scholarship (but) we're excited and scared to death at the same time."

The importance of alleviating unnecessary fears while identifying genuine issues cannot be underestimated in establishing viable administrative policies.

Over the past few years, the National Center for Higher Education Management Systems (NCHEMS) and its subsidiary, NCHEMS Management Services, Inc. (NMSI) have helped dozens of colleges and universities assess their current academic and administrative computing plans, and develop appropriate strategies for the future. Although different institutions have different computing needs and requirements, every institution is beginning to have a common problem: What to do about the microcomputer explosion on campus?

This paper examines the results of a NMSI survey to 30 major colleges and universities on the strategies and policies adopted for the acquisition and use of microcomputers on campus. Insights which were gathered from the survey will be presented in the following sections: Pace-Setters and Influencers; Factors Affecting The Acquisition and Use of Microcomputers; Acquisition Policies, Procedures, and Arrangements; Measures of Adequacy; and Effects on the Infrastructure. The paper concludes with a summary and some comments regarding the survey. Either author may be contacted for more information about the survey.

Special recognition needs to be give to Dr. Jana Matthews, for the many hours of work she provided in preparing for this activity, and working with the interviewers to prepare a report.

Table of Contents

Introduction 1
The Respondent 1
The Instrument 1

Pace-Setters and Influencers 2
Introduction 2
Pace-Setters 2
Influential Factors 3
Summary 3

Factors Affecting The Acquisition and Use of Microcomputers 4
Introduction 4
Limiting or Inhibiting Factors 4
Encouraging or Accelerating Factors 5
Factors Causing Change in Pattern of Acquisition 6
Summary 6

Acquisition Policies, Procedures, and Arrangements 7
Introduction 7
Acquisition Policies and Procedures 7
Special Arrangements 8
Summary 8

Measures of Adequacy, Effectiveness, Efficiency, Usefulness, Etc. 10
Introduction 10
Measures of Adequacy 10
Measures of Saturation 11
Summary 11

Effects on The Infrastructure 12
Introduction 12
Computing Facilities 12
Telecommunication Facilities 12
Electronic Mail Systems 13
Staff 13
Summary 14

Summary 15

Introduction

This study began in November, 1984, when Dr. Jana Matthews, then President of NMSI, met with Dr. Vinod Chachra, then a Senior Program Consultant, to discuss the Workstation Strategy Study. It was decided the most feasible strategy was to select a set of institutions, send the questionnaire/interview guide to the President of each institution in the sample, and ask him/her to appoint a designee to respond via a telephone interview. Gary Devine, Wayne Donald, Jim Vanderpool, and Michael Zastrocky were selected to conduct to phone interviews, and assist in preparing the final report. They also suggested several additional types of information that could be collected during the interviews.

The Respondent

NMSI chose to contact Presidents directly, thereby eliciting their tacit support for the study. It was felt they would appoint the most appropriate person on campus to respond to the questions being posed through the interview. It was also reasoned the designated person would respond fully to the interview, knowing the President had appointed him/her to respond on behalf of the institution.

NMSI staff called each Presidents' office to ascertain the name and telephone number of the person designated to be interviewed. In all cases, the person being interviewed had studied the questionnaire, and had collected some of the required data ahead of time. Those interviewed were prepared and participated willingly in the interview process. It is felt they gave the best information and estimates they could provide.

The Instrument

A revised instrument was field tested at five institutions, and after some minor modifications mailed to all Presidents of the institutions that were included in the sample. It was a difficult set of questions for people to answer, but the institutions responded to the interview because they felt the issues were important ones, and because they felt it was important to share and find out what other institutions are doing.

The instrument was 8 pages in length, and therefore important that designated persons had to interview guide ahead of time. The instrument was broken into four major area:

- Institutional Profile
- Current Profile of Workstations on Campus
- Concrete Plans for Next Year
- Future Computing Plans - 1989-1990

Pace-Setters and Influencers

Introduction

The impact of the media on all aspects of life is readily apparent. Glaring headlines and blaring television and radio reports proclaim the day's "saints" and "sinners," the "haves" and the "have-nots." In recent years institutions of higher education have not been immune to the power of the media. One arena in higher education that has been heavily influenced by the media is athletics. The prestige and image of an institution is often carried to the field of play. A new arena in higher education is the arena of technology. Institutions recently have become more adept at using the media to promote their "technical prowess." New high-tech programs on campus, major donations of high technology equipment and expertise, and microcomputers "going to college" have been cited in the media. This coverage is having an impact on the image and prestige of some institutions.

Who are considered by their peers to really be the pace-setters in technology in higher education? Do they influence decision making at other institutions? Is there a sort of "peer pressure" operating in the acquisition and use of workstations in higher education? Are institutions trying to emulate programs or characteristics of those perceived leaders, or are they perhaps operating in a mode of "Mutually Assured Computing"?

Survey results indicate that there are a group of institutions who a re perceived to be pace-setters by their peers. Results also point to some other factors that may be influencing decision making and operations at the surveyed institutions.

Pace-Setters

Responses to several questions in the survey indicate that while some names frequently surface as "leading institutions," these "leaders" seem to wield little day to day influence over other institutions in their quest for understanding and in defining the role of workstations on campus. It is interesting that many schools expressed more concern about "keeping up with the other people in the neighborhood" than with trying to emulate the pace-setters, although several institutions were quick to point to their recent hiring of key people from the leading institutions. Respondents appear to be influenced much more by their peers (other schools in their athletic conferences, their region, or other schools similar in size, status, and mission) than by the schools who get publicity and donations for leading-edge projects and programs.

The top five vote receivers listed in response to the question "Name the top three institutions which you consider leaders in acquisition and use of WKS on campus," are listed below.

Institution	Number of Responses
Carnegie-Mellon	23
MIT	15
Brown	10
Stanford	10
Dartmouth	4

In response to the questions, "Are computing directions at your institution influenced by what other institutions (neighbors or peers) are doing?" and "If yes, what institutions influence your institution?" the top five are listed below.

Institution	Number of Responses
Carnegie-Mellon	3
MIT	3
Stanford	3
University of Wisconsin	3
Brown	2

The rest of the responses included general and specific references to peers and a host of schools from the athletic conferences of the reporting institutions.

Survey results indicate that many of the institutions who are perceived by their peers to be leaders in the acquisition of workstations, are not considered by these same people to exert influence on their own institutions. For example,while Carnegie-Mellon is perceived to be a "leader" by 23 respondents, it is perceived to exert influence on only 3 of those same institutions. Also, the clear majority of respondents listed at least one institution from within their own athletic conference, their own financial arena or local region as an institution which influences their "computing directions." This tends to imply that while national reputation may influence whether or not an institution has a name as a high-tech leader, actual operating influence is greater among those institutions deemed to be "peers."

Influential Factors

Respondents were asked to list "factors encouraging or accelerating acquisitions: Internal and External." One cluster listed peer-pressure, one-ups-manship, or neighbors as internal factors encouraging acquisitions. Another cluster listed peer-pressure, marketing strategies, national trends, other institutions or public relations as external factors encouraging acquisitions.

A similar question asked respondents to "rate external factors that are likely to influence plans to acquire WKS" for 1985-86 and 5 years from now. The clear majority (28 of 30 for 1985-86 and 25 of 30 for 5 years from now) rated peer group pressure as a positive or a very positive influence. What may be even more interesting is that over 1/3 of the institutions rated "peer group pressure" as a more positive influence for 1985-86 than "availability of funds," and over the next 5 years, more than 1/4 considered "peer group pressure" to be more influential than "availability of funds." In the same vein about 1/4 considered "peer group pressure" more influential than "deals" with vendors for 1985-86.

Summary

There are several institutions who have built strong reputations as "leaders in technology." However, it seems that many of the institutions surveyed are more concerned with their peers and feel more pressure from their "neighbors" than from the leaders when making decisions. Also, the ability to hire key personnel from the leaders seems to be important and enhances the image of the institution. It appears that the respondents may be more concerned with parity amongst the competition and the real measure of effectiveness of the policies and decisions made may be decided by the numbers and quality of the students who show up in the fall. Finally, although financial considerations are considered important when making decisions on the acquisition of workstations, peer pressure may be even more important.

Factors Affecting The Acquisition and Use of Microcomputers

Introduction

Planning a strategy to gain control of the acquisition and use of micros requires that the institution ask:

- What negative factors should we be aware of that could hinder our progress?
- What positive factors can we concentrate on to achieve the most beneficial impact for our efforts?

The study considered current and long-term influencing factors, and attempted to separate those that originated from within the institution from the external factors. No single factor appeared to be predominant. However, a number of influential factors all point to an undeniable conclusion - the evidence of management commitment is the catalyst for any of them to lead to a successful program.

We will first examine some of the negative factors, which fortunately are few. We will also look at the positive factors we found, and discuss how some of them may be used to influence the pattern of acquisition and use of microcomputers.

Limiting or Inhibiting Factors

Not surprisingly, the lack of funding was most often cited as a limiting factor. As we shall see, though, simply pumping money into the program is not the total solution to this problem. One variation that is particular to small schools is the inability to establish quantity discount programs.

The wide-open marketplace , while quite competitive, can also be unnerving for a lot of users. They are confused by the vast array of hardware and software on the market, and are often further confused by "advisors" who have their profits in mind more than the users' needs. Because technology changes rapidly, some are hesitant to make a purchase for fear it will soon be obsolete.

Even though micros are becoming more commonplace, they are still computers, and are still a fearful mystery to some. Part of the problem is felt to be a lack of awareness of the benefits to the particular individual, and part is attributed simply to the fear of failing at something new and unknown.

Although it was not mentioned frequently by itself, discussions of many positive factors often led to the conclusion that none of them would work without proper evidence of "management commitment". Without it, microcomputers seem to be viewed as "playtoys", or at least not "real" computers that solve "real" problems. Restrictive purchasing procedures are seen as an attempt by management to keep microcomputers out, which they don't. They get bought anyway, but come in through the back door under all sorts of disguises, always labeled as anything but a computer. So lack of management support may discourage some, but mostly it causes the institution to lose control of microcomputer acquisition and use.

Encouraging or Accelerating Factors

Existing Demand: For the most part, this is the least of the institution's problems. Because of a great deal of media exposure, and examples of friends or colleagues who are productive with microcomputers, there is a lot of peer pressure, and a general feeling that this is something everyone really should do. Many people are at least vaguely aware of what sorts of things a microcomputer does and how it can benefit them, and feel that not getting started using one will cause them to fall behind in their profession.

Management Commitment: Inclusion of micros in long range computing plan and budget seems to be the single step to show that management really is committed to microcomputers as a computing resource, especially where computing funds are redirected to this new resource. If they are addressed in a separate plan, there is the impression feeling that they are not considered to be "real" computers, and run a poor second to those that are.

Especially important is the commitment of special staff to do microcomputer support exclusively. Some institutions have hired in staff who are already familiar with such a support operation.

Streamlined purchasing procedures are seen as encouragement to acquire and use micros. Central approval by support staff is not seen as inhibiting if the rest of the steps are simple and direct. Many of the restrictive procedures in place were created for far more expensive computers, with nothing new being done with the advent of newer, less expensive equipment.

Establishing agreements with a small number of vendors for a standardized set of products reduces the fear associated with a wide-open market, and instills some degree of confidence in the products selected. Again, if management shows encouraging signs, then users are more likely to invest the time and money necessary to start using a microcomputer.

Funding Assistance: Volume discount programs of some sort were the most popular method of monetary support. Establishing campus micro "store" or a buying arrangement with the bookstore can often channel the volume sufficiently to take advantage of vendors' volume discounts. If an operation in the bookstore is chosen, prices are usually somewhat higher, and the emphasis on identifying user needs less than that found with special support staff consultants. For schools that are too small to generate the volume required by most vendor discount programs, the buying consortium can provide the answer. Small state institutions can look to share in the arrangements made by their state government agencies.

Additional money was cited as being beneficial only if it is accompanied by increased support from management. Cost sharing by the institution is seen as more effective, the rationale being that the individual's investment will be cause for a greater personal commitment.

Lastly, one should not forget that the prices of micros and their related devices are continually decreasing.

Skills Development /Outreach: Beyond making arrangements that facilitate acquisition, the institution has to follow through with encouraging the most productive use of the equipment and software. Some suggested starting with introductory seminars that discuss the benefits of micro applications, and include "hands on" demos, to ensure awareness of possible benefits, and overcome the fear of failure. Continuing education includes seminars for installed products, especially for beginners. A newsletter keeps users informed of successes of their peers, and offer valuable education through "tips and tricks" items.

Support staff trained to identify needs first, and products later make a valuable contribution by leading new users directly to productive efforts. After having gotten them started and trained, the support staff, knowledgeable in a small number of products, can offer "hotline" support, and keep the users operating through day- to-day crises.

As users become more adept, they may develop applications that would be usable by their colleagues, and they should be encouraged to share their work. An offer of anonymity must be made, however, to allow the developer to avoid a potential flood of support calls from new users. Certainly, one of the best ways to ensure development of software that will be usable by others in the institution is to encourage use of micros in the classroom. For instance, one university has an annual grant program that funds proposals for the most creative and effective use of microcomputers in the curriculum.

Factors Causing Change in Pattern of Acquisition

The institution can steer buyers in the direction they want by indicating its wishes through some of the positive factors we have already examined.

Agreements with a small number of vendors for a standardized set of products presumably would be for the kinds of products the institution wants to see used. Likewise, volume discount arrangements would not be made for products the institution does not want. Especially in a cost sharing arrangement, the institution can express its desires for the types of products used, but also where and by whom.

While being careful to satisfy user needs, support staff recommend only those products that can be supported later. The user may be allowed to purchase other items, anyway, but will receive no "hotline" support for them. Inclusion of a central approval point in the purchasing process can ensure that the same kind of advice is given to all buyers.

Introductory seminars discuss benefits of applications of the kind that the institution finds desirable, providing an influence from the very start of the users' experience.

Also, through academic grant programs, the institution can encourage the kinds of applications it would like to see offered in the curriculum.

Summary

Because of broad media exposure and peer pressure, buyer demand already exists, but there is also some fear.

While a lack of money is very inhibiting, throwing money at the problem is not as important as is evidence of management commitment. Discount programs, and other means of assistance, can be implemented, and prices are always dropping. Any solution should be part of the long range computing plan and budget. Assistance is also needed for developing skills for the beginner, offering day-to-day guidance, encouraging creative use by more advanced users, and then encouraging them to share their efforts with their colleagues.

Without administrative support and commitment, a negative feeling exists that discourages some buyers, but also may cause the institution to lose its control over the acquisition and use of micros.

Emphasis on some positive factors can set the pattern for acquisitions. Demand can be guided by supporting and developing expertise in the use of institution-preferred products and applications.

Acquisition Policies, Procedures, and Arrangements

Introduction

Not too many years ago, data processing procurements in a university environment were basically normal procedures. Some state supported institutions had control agencies for data processing procurement activities, but most institutions utilized their already existing purchasing procedures and offices.

Acceptance of the microcomputer into higher educational activities caused many changes. The workstation concept had a tremendous impact on academic, research, and administrative computing from the outset. Curriculum changes to incorporate microcomputers placed varied demands on computing resources. Private institutions attempted to meet these demands by being the first to require students to have their own workstation for use while attending the institution. In some areas of the country, students began arriving on campus with their own workstation. In addition, microcomputer laboratories were one answer for many institutions in meeting immediate demands. Technological advances provided researchers with more resources in the laboratory and better opportunities to compete for valuable research funds. Administrative systems on a standalone workstation reduced dependence on mainframes and provided flexibility in analyzing and presenting all types of university data.

Results of this survey support the impression that workstations have made an impact on higher education. This section examines acquisition and purchasing policies, procedures, and arrangements for the participating institutions and provides an insight into workstation trends in higher education.

Acquisition Policies and Procedures

The influx of workstations in universities over the past two years is astounding. Institutions that participated in this survey provide figures that clearly support the growth of workstations in the educational environment. The 30 institutions interviewed had purchased over 10,000 workstations in 1984. What is even more impressive is the projected growth of workstations to be purchased by the institutions in 1989-90 -- 115,000. Private institutions project a workstation growth at the rate of approximately 50% per year; public institutions project a workstation growth approaching 100% per year. These figures and projections are only for workstations owned by the institutions; they do not reflect workstations purchased by faculty, staff, and students with personal and/or special funds. This type of workstation growth necessitates the decision and implementation of purchasing policies and procedures.

Some coordination for purchasing institutionally funded workstations appears to exist in all the surveyed institutions. Most institutions interviewed have some type of centralized purchasing procedure. One definite aspect of the centralized purchasing procedures is involvement of computing personnel in an approval process. The degree of involvement and type of person(s) varied between institutions -- Manager of Office Automation, Director of Computing, campus computer store, Associate Provost for Computing, Vice President for Computing. Computing personnel were also instrumental in most of the institutions using decentralized procedures in the approval process. Few of the institutions interviewed responded that computing personnel had no involvement in the process for purchasing institutionally funded workstations. These results indicate that institutions, whether with centralized or decentralized coordination of purchasing, are involving computing personnel in the approval process. This type of "monitoring" by specialized personnel will certainly ensure some level of standardization and should produce financial savings through proper equipment purchase and vendor negotiations. The actual approval process varies, but purchases are normally initiated at the department (or project) level and then are processed through a series of approvals before an order is issued.

It is common today for some states to act through certain controls in the procurement process. These states often negotiate with vendors for special state contracts. For the public institutions interviewed, less than half have no state contract offering. Of the public institutions with state contracts, only one indicated it was able to secure better prices through a university contract with the vendor. The public institutions with state contracts did not specify whether they are "required" to purchase from state contracts or whether they might have the freedom to negotiate separate institutional contracts. Only one private institution interviewed has a state contract offering, and that was available only through a consortium. Many vendors are approaching single institutions and consortiums for special purchase arrangements. This type of vendor marketing could cause problems with those public institutions that do have some level of state control and state contracts.

Special Arrangements

Special arrangements for workstations are either special funding arrangements or special purchasing arrangements. Only one institution responded positively to the question of tuitions and fees earmarked for workstations. This response was from within one of the professional schools at the institution. Three other institutions have proposals in one stage or another for tuitions and fees earmarked for such purposes, but each feels that it will be 2-3 years before any results are realized.

Administrators are extremely sensitive to earmarking tuitions and fees for workstations. The cost of higher education is increasing annually; consequently, institutions requiring workstation purchases are developing innovative options for financing such purchases. However, many institutions will continue to meet the student need by providing "public access" labs around the campus. Those institutions that do require the student to have a workstation will continue to develop alternatives and negotiate for special purchasing arrangements. Earmarked tuitions and fees for such purchasing will probably continue to be a rare sight and not a viable alternative.

On the other hand, special purchasing arrangements continue to increase. Almost a complete majority of institutions interviewed have some type of special arrangement with one or more workstation vendor. Most special arrangements with vendors allow full-time faculty, staff, and students to purchase workstations at an attractive discount. Interview responses indicated that approximately 75% of all workstations purchased with private funds by faculty and students were purchased through special institutional arrangements. This high percentage indicates that these individuals appreciate the opportunity the institution offers for workstation procurements. One overlooked aspect of this situation is the willingness of workstation vendors to work with institutions of higher education for special purchasing arrangements.

Summary

It is quite obvious the tremendous growth of workstations will continue for the next 5 years. This growth rate will impact many areas within an institution. Most institutions interviewed have some type of centralized purchasing to handle their anticipated workstation growth. Because of different characteristics, the type of central purchasing varies from one institution to another. What it basically means is that somewhere within the process a person or group will advise, oversee, and/or be responsible for workstation (in some cases it might be all data processing) acquisitions.

When such a centralized procedure is implemented, most institutions have found it advisable to have data processing (normally computing resources) personnel directly involved. Their involvement could simply be an advisory role, but most institutions have found it important to include computing resources in the actual approval process. Such involvement is important for several reasons. At most institutions, computing resources is knowledgeable of what workstations are currently being used, and what is available in the market. If an institution allows too much diversity in workstation vendors, problems will arise in many areas, particularly support. Therefore, computing resources involvement can provide some level of standardization in workstation purchases. Another reason to include computing resources in this approval process is they are normally the group that will have to provide internal support -- support for hardware, software, maintenance, and perhaps, communications. It is very difficult for computing resources at any institution to be put in a position where they have to "react" to a workstation environment. It is much better to have them in the approval process so that support issues can be addressed "before" purchases are approved. Finally, having computing resources involved in the process provides the opportunity to negotiate special agreements with vendors. Not only special agreements for hardware, but also for software, maintenance, and so on. With centralized procedures an institution normally has more leverage to discuss special agreements to benefit everyone involved in workstation purchases.

The responses in these interviews and other publications in higher education show such centralized procedures have worked. When you think about it, it's a natural. If your institution is purchasing supplies, a much better "deal" can be arranged if you standardize on brand, color, type, size, and so on than if an individual department approaches a store or dealer. The same is true with workstations. The workstation growth in the next several years is going to require institutions to consider these issues if they want success in their workstation environment.

Measures of Adequacy, Effectiveness, Efficiency, Usefulness, Etc.

Introduction

Few people would challenge the observation that the microcomputer has "come of age." Microcomputers are found virtually everywhere, in businesses, industry, education and numerous other professions. Microcomputers have also become a symbol of efficiency and status. While some people might still argue about the usefulness or pervasiveness of microcomputers, that they exist in quantity on campuses is less arguable. How do institutions measure the usefulness and effectiveness of microcomputers in higher education? How do they know when they have reached the right mix of micros and minis and mainframes? Is there a formula or ratio that will help institutions know when the mix is right or when saturation is reached? Have we developed a technical measure of adequacy or effectiveness?

Not long ago, computer center personnel would measure the adequacy of computing resources on campus by walking to the computer center or computer lab and counting the number of students (or faculty) waiting in line to use a device. If the lines were long and if they remained long until after midnight, then it might have been judged that the resource was becoming inadequate. Another criteria that was often used to evaluate adequacy was system response time. If users had enough time between screens to go to the restroom or get a cup of coffee and a sweet roll, then system performance was likely to be appraised as being inadequate.

Are these "measures of adequacy" appropriate for workstations today? Can institutions judge adequacy by measuring length of lines or by measuring response time, or are there other measures that are appropriate for measuring the adequacy of microcomputers on campus? Do the institutions in the survey have a precise formula for measuring adequacy or are they operating by "the seat of the pants?"

The results of the survey provide some interesting insights into the issues surrounding "measures of adequacy, effectiveness, efficiency, usefulness, etc."

Measures of Adequacy

While the survey supports the almost universal acceptance of microcomputers on campus, it seems clear that none of the institutions surveyed, small or large, public or private, have devised or even thought about the issues surrounding measures of adequacy. Of the thirty institutions interviewed, none used any standard measure of adequacy and one candidly stated they "didn't know of any in use." It appears that no technical measure for measuring adequacy or effectiveness is currently being used or even thought to exist by those surveyed. This is particularly interesting when reviewing data from the questionnaire which indicates that the 30 institutions surveyed have already purchased more than 10,000 workstations and expect to add more than 10 times that amount by 1990.

The results of the survey seem to imply that either some informal, "non-technical" measures of adequacy or some other measures are being used to define adequacy and saturation.

Measures of Saturation

What does saturation of microcomputers mean to a college or university? Does it mean that everyone who wants one has one, or does it mean that some people need none while others may need several? Survey responses indicate that institutions are struggling with the issues surrounding saturation. Respondents were asked to identify possible microcomputer/faculty ratios for 1986 and 1990 and microcomputer/student ratios for 1986 and 1990.

There was a cluster of institutions who expect a microcomputer/faculty ratio between 1/1 and 1/4 by 1986. Another cluster expects a ratio somewhere between 1/5 and 1/10 by 1986. The majority indicated that they weren't sure what the ratio might be by 1986. Regarding the microcomputer/student ratio for 1986, there was a cluster of institutions who expect a microcomputer/student ratio around 1/10, another cluster that expects a microcomputer/student ratio greater than 1/10 and again the majority indicated that they had no idea what the ratio might be. It seems that institutions have some rather vague notion concerning saturation levels for faculty and students for 1986 but it does not appear to be a sophisticated technical approach to the issue that is driving the acquisition process.

The idea of saturation levels for 1990 seems to have more meaning for the respondents saturation levels for 1986. The majority of institutions indicated both microcomputer/faculty and microcomputer/student ratios of around 1/1 would be a good indication of saturation by 1990. A few respondents gave various responses including one who defined saturation for 1990 as that point "where the number of microcomputers equaled the number of typewriters and calculators on campus," and another who indicated that saturation might well mean a ratio greater than 1/1.

The question was asked if saturation would be reached by 1990, and if not why? The clear majority of institutions surveyed indicated that saturation would not be reached by 1990 and funding was listed as the major reason for not reaching saturation by 1990. There was another cluster of respondents who indicated that people concerns, training and staffing, would be an important factor in the quest for saturation. While responses did not appear to vary by region of the country or size of the institution, private institutions expressed more optimism in reaching saturation by 1990 than did public institutions. More than 1/3 of the private institutions surveyed believed they would reach saturation by 1990 while 1/5 of the public institutions surveyed expected to reach saturation by 1990.

Summary

There are several interesting aspects about measurements of adequacy and usefulness of microcomputers on campus as addressed in the survey. (1) It appears that there are no technical measures for evaluating adequacy, effectiveness, efficiency, and usefulness of microcomputers on campus (or if there are, they are unknown to those surveyed). (2) While a significant number of microcomputers are expected to be purchased next year, the acquisition of these units does not seem to follow some formula or pattern based on a measurement of adequacy or usefulness. (3) Looking ahead to 1990, while many institutions indicate a saturation level of 1/1 might be a worthwhile goal, there does not seem to be a formula or pattern that others may be willing to follow. It is possible that institutions may not acquire wisdom in this area until they over-invest and measure what does or doesn't happen with microcomputers when a saturation level of 1/1 is reached. (4) Other factors including availability of funds and personnel may have more of an impact than measures of adequacy, efficiency, effectiveness, or usefulness when addressing the issues surrounding acquisitions of workstations.

Effects on The Infrastructure

Introduction

Many institutions that have acquired large numbers of microcomputers have not considered the impact of these devices on other computing resources. Central computing facilities, communication networks, and staff often experience significant increases in demand almost overnight. Accommodating these increases may require substantial investments. Once the commitment is made to acquire microcomputers in substantial numbers, demand for community services will increase, and the entire computing infrastructure of the institution will be placed under pressure - pressure for access to central data bases and storage facilities, for electronic mail and message services, high-quality printing and plotting, and expert advice. The common facility which is involved with all of these services is the campus telecommunications system.

The successful assimilation of microcomputers into the academic environment will depend to a great extent upon the availability of institutional support for a wide range of facilities and services.

Computing Facilities

If other computing facilities have software or data files which many people wish to access, the terminal emulation and data manipulation capabilities of microcomputers serve as convenient and effective tools for accessing them. Microcomputer users recognize this potential and request or demand access to these facilities. Unless the institution, in planning the acquisition or microcomputers, anticipates this demand, the results can be surprising and can present significant dangers to the integrity of institutional data.

It is quite natural for users of microcomputers to wish to access central administrative data files. The extraction of accounting data for those accounts over which one has responsibility or data regarding the students in the classes offered by an academic department for processing by a spreadsheet program or data base management software can replace manual record-keeping or provide new analytical capabilities. As the volume of this type of access increases, it can have a negative impact on the response time of other applications, and once such access is allowed to occur, it is difficult to stop. In addition, unless adequate security is provided on the central computer, it can be possible for the microcomputer user to perform unauthorized alterations of the data in the central files. As microcomputer users become more sophisticated, they will also likely want additional software capability on the central computer and they may want to create special data bases or files on the central computer. This new demand for disk storage may not have been anticipated in the planning process.

Telecommunication Facilities

Access to other institutional computers occurs primarily through the use of existing telephone lines. It is a relatively simple matter to connect a microcomputer to telephone lines using an inexpensive modem and then to gain access to computers on campus or literally anywhere in the country. This can be a convenient and apparently inexpensive way to access data bases, exchange data with other microcomputer users, and extend the capabilities of the microcomputer through access to software and other facilities of other computers.

Most telephone systems were designed and installed to handle only voice communication. The length of the average telephone conversation was assumed to be four or five minutes. As computers became more sophisticated, it became possible to use these same voice communication lines for the transmission of data and for communication between and among computers. The length of the average data transmission session is much greater than that of the typical telephone conversation. It is not unusual for computer communication sessions to last for hours. While this often created noticeable problems with existing telephone systems, the problem quickly became acute for many of the institutions which acquired microcomputers in large numbers. The number of people using the telephone system for data communication increased dramatically almost overnight. It became more difficult to get dial tone, busy signals became increasingly commonplace, and requests for new telephone lines exceeded the capacity of the telephone switching equipment.

The solution to this problem for most institutions is the replacement of the entire telephone system with new equipment which can accommodate both voice and data communication. Such systems often require replacing the entire telephone cable plant, all telephone sets with new electronic phones, and hiring of staff to operate and maintain the new equipment. Frequently a new building or major remodeling of an existing building is required to house the new equipment.

Costs are generally measured in the millions of dollars. It is significant that the majority of institutions in the survey have recently installed new telecommunications systems, are currently involved in such a project, or plan to replace their existing systems in the next few years.

Electronic Mail Systems

Over the past few years, many institutions have implemented electronic mail and message systems. Usually operated from central institutional computers, they have provided convenient communications among computer users. Using a computer terminal, a user can compose a message on his screen and transmit it to a central computer, where it is stored until the individual to whom it was addressed accesses it via another terminal. Because this type of communication occurs one line at a time and editing capabilities are limited, messages tended to be short.

But the introduction of the microcomputer, with its local processing and storage capability, has increased the flexibility of electronic mail and extended it to include the creation and electronic transmission of entire documents, often many pages long. Using word processing or text-editing software, the microcomputer user can create long documents, edit them, and store them on floppy disks. The electronic mail facility can then be used to transmit the entire document to one or more other users of the mail system, each of whom has a complete electronic copy which can be stored, manipulated, and printed or re-transmitted to still other users.

The effect has been increased consumption of network facilities, in terms of computing cycles, network connections, and especially disk storage.

Staff

The introduction of microcomputers will require new and different skills on the part of staff who are responsible for providing computer support. Advice and consultation on the best brand of microcomputer, the most effective software, the cheapest modem, and countless other aspects of microcomputing will be needed. If staff are not identified and trained for this role, anyone with any knowledge at all will become the target of the inquiries and questions. By providing this kind of staff support, the institution can more readily standardize on a brand or brands of microcomputer and, in many cases software. Certainly, the items with which staff are familiar are more likely to be chosen by the novice. The quality of advice and consultation can be controlled more easily if the staff are given responsibility exclusively for microcomputer support.

It is easy to underestimate the knowledge required by microcomputer support staff. Potential microcomputer users want comparisons of the advantages and disadvantages of different brands of hardware and software. While it is becoming increasingly common for institutions to standardize on basic equipment and, in some cases, software, it is unlikely that standard items will satisfy the diverse requirements of faculty, staff, and students. This diversity of configuration of hardware and software is one of the most significant advantages of the microcomputer in higher education, but also requires a very broad range of knowledge on the part of the support staff.

Training for the use of microcomputers is quite different than most training that has been accomplished for computing prior to now. New skills are required to teach computing to beginners, where often the greatest task is to get them beyond a fear of computers. Traditional user training has been for users of systems developed by data processing, with well-defined functions. User training in our context is showing users how to do their own computing, which is far more open-ended and creative. Some institutions have hired staff who already have those skills, rather than attempting to develop them in current staff. In any case, additional staff are required for training, and they may well be different from those who are doing consulting. Similar "people" skills are required, but the necessary organization and presentation skills are quite different for the consultant and the teacher.

Summary

The introduction of microcomputers on campus can have a significant impact on other facilities. Communication with other campus computers to query data bases, access specialized software packages, or take advantage of large data storage capacity will be commonplace. The impact of this communication among computers on institutional telecommunications and data communications facilities is likely to be substantial.

Of the 30 institutions surveyed, 24 expect the acquisition of microcomputers to increase the requirement for other computing resources on campus. A number of reasons were cited for this anticipated increase. Some felt that microcomputers would serve to acquaint large numbers of people with the value and potential of computing and that this will, in turn, result in increased demand for access to other institutional computing resources.

Nearly all of the institutions reported either that they have or expect to have electronic mail in the near future and while this service was the one most frequently mentioned, institutions also indicated plans for a variety of other services, including access to commercial data bases, national computer networks, on-line access to typesetting and printing service, and campus-wide electronic bulletin boards.

Among the reasons given to support a belief that microcomputers will decrease the need for other computing resources were the expectation that work will be done on microcomputers rather than on larger computers. One institution reported that the mainframe computer is now used only for word processing, a function that can easily (and more effectively) be accommodated on microcomputers. One institution interviewed believed that there will be an increase in need for other computing resources followed by a leveling-off as the larger computer(s) are used mainly for administrative data bases, large files, and specialized software.

Summary

The interviews revealed a number of issues about microcomputers on college campuses, however, some of the more interesting issues revealed were those not directly addressed by the questionnaire. Before the interviews began, it was assumed most institutions had dealt explicitly with both the policies and the practical issues associated with assimilation of this new form of technology into their computing environment. As the interviews got underway it became apparent that most institutions have not, in fact, planned the broadscale introduction of sophisticated workstations into the campus computing environment. This is not to suggest that chaos reigns and that all microcomputer acquisition and use decisions are left entirely to the individual faculty, staff, or student. However, few institutions interviewed have actually developed a strategy for the integration of sophisticated microcomputers into their overall computing environment.

Institutions that are dealing with this issue are finding there are many questions still unanswered, both at their institution and many institutions around the country.

- What is the role of computing (including microcomputers) and communications on the campus?
- Who should be responsible for the policies and purchasing issues dealing with microcomputers?
- If microcomputers are to be widely accepted on the campus, is standardization necessary?
- Should students be required to purchase microcomputers? If not, how does the institution support programs and needs? If required, how does the institution support the program?
- What is the plan for integration of microcomputers into the curriculum? How will students use such a device?
- What will be the impact on the infrastructure of the institution?
- What is enough?

The list can go on, but the important point is that institutions must realize new technology is going to have an impact on the institution. In order to prepare for the new technology, top level administrators must take steps to plan and develop a strategy for the integration of workstation devices into the overall computing and communications environment. "If you go as far as you can go, you will see farther when you get there."

STRETCH YOUR PC DOLLARS — BUY CLONES

by
Dr. John F. True
Director, Computing Services
San Francisco State University
July, 1986

ABSTRACT: With limited state resources and demands for microcomputers increasing exponentially on campus, an opportunity to purchase twice the number of PC workstations for the same dollars available becomes very intriguing. Questions of compatibility, vendor longevity, support, and other risk management issues must be weighed against the low cost of import products. This is the story of how this campus evaluated the off-shore PC look-alikes, considered some of the risks involved, and decided to purchase over 100 of these units.

BACKGROUND

According to the old management maxim, "If you see a parade forming, you can either get in front of it and lead it, or watch it go by, or get run over by it." Recently I saw a parade forming. It began in the form of casual inquiries by (younger) faculty members as to why we were not taking advantage of the low-cost IBM PC compatible products appearing on the market and the frequency of inquiries was increasing.

As the campus official responsible for approving all computer acquisitions, I had never enforced a standard product policy directly. However, by only providing maintenance support for selected products, we have had a defacto standard for IBM and Apple microcomputer products. At a meeting of our Instructional Computing Advisory Committee (ICAC), a straw poll indicated that departments were ready to purchase as many as 100 PC clone units immediately. The parade had indeed formed and it was time to take the baton.

WHAT ARE THE ISSUES?

The typical university response to any situation is to form a committee to study the problem. A subcommittee of ICAC was formed to study the issues of PC clones. They surveyed the recent literature (there is no history or performance track record of these new products) and reported their findings and recommendations to the full committee.

They found that several large corporations are evaluating and purchasing low-cost IBM PC compatible computers as are a few other institutions of higher education. From advertisements and vendor discussions, they determined that a generic PC/XT with dual 360Kb drives, 640Kb RAM, Hercules compatible card, 135 watt power supply, serial port, parallel port, clock calendar, keyboard and cabinet with at least five expansion slots could be acquired for less than $800 each in quantity purchases. They did not find any hardware horror stories.

They recommended that the University acquire PC-XT clones for evaluation and use during a three year period. They recommended that for maintenance purposes every fifth unit (or 20% of the purchase amount) be transferred to the pool of spares managed by Computing Services. In return, Computing Services agreed to provide full maintenance for the units for three years. Three years was picked to coincide with the length of the pilot project and was based on the fact that we did not know the useful life expectancy of these units. The twenty percent figure works out to about 6.7% per year which is less than the national average of 10% per year.

Having accepted the subcommittees' recommendations, we in Computing Services set about identifying other issues and developing selection and implementation plans. This was to be a $100,000 procurement (our institutional limit above which the State Department of General Services must conduct the procurement) and risk management issues quickly surfaced. For example, do these off-shore imports have Federal Communications Commission (FCC) and Underwriters Laboratory (UL) approval? Can some of the upstart companies that assemble these units deliver in quantity and will they be around next year? Which unit would we select and will there be bid protests from other vendors? Can we find one or two units to "standardize" on for the pilot project? Would these units need monochrome or color monitors, graphics adapters, LAN connectors, and which style keyboard would be appropriate?

LET'S SEE WHAT'S AVAILABLE

After reviewing these issues, the other management maxim which states, "Nobody ever got fired for buying Big Blue," crossed my mind and I wondered why I was out testing new waters. The results of the issue review told us that we needed to involve our campus Purchasing Department and some users in the selection process. We formed such an ad hoc group, wrote some preliminary specifications, and invited vendors to bring their products to a Low-Cost PC Faire (internally we called it a "clone-off"). Several vendors brought a total of eleven units to our Faire which lasted one week. We set the units up in one room and invited faculty and staff to bring their favorite software to see if it would run on these units.

The general criteria for the entry of a unit to the Faire included:

1) Advertised IBM PC software compatibility
2) Keyboard plug compatible with the IBM PC
3) Memory size: 640 Kb
4) Empty slots for expansion
5) Monochrome monitor
6) Hercules or Hercules compatibility for monochrome monitor or color graphics adapter with (composite) monochrome monitor
7) Provide list price, warranty information, and delivery time
8) Clock/calendar with battery backup and software to set it
9) One parallel and one serial port
10) Power supply: UL/FCC approved
11) Two DSDD disk drives, 360 Kb, half height if possible
12) Include 8087 co-processor if possible
13) Provide documentation on system setup and operation

The University supplied the printers and reserved the right to install additional cards (i.e. LAN adapters). We, of course, assumed responsibility for security and damages while the units were on campus.

EVALUATION PROCEDURE

We planned four types of evaluations. The first was a simple survey of responses from those attending the Faire. They were asked to rank their favorite units as well as ranking those they found unacceptable and to supply comments.

The second test involved software compatibility. We tried to load various commercial application software packages on each unit.

The third test dealt with hardware compatibility and performance. We inserted LAN adapter cards in each unit and tried to establish communications with our 3Com LAN. We also ran some "workout" benchmark software on each unit to time random disk reads and writes, sequential disk reads, and prime number generation.

The fourth evaluation criteria was the "unofficial ball park price" which we obtained from each vendor. We asked for these unofficial quotes on quantities of 25, 50, 75, and 100 units.

Although not part of the formal evaluation, we did schedule a couple of hours with each vendor during the week to obtain information about vendor support, longevity, and additional product data. The vendors were all quite excited about the Faire and eager to participate and please. It was during one of these sessions that one vendor said, "I hear you would be interested in a three year warranty and we will provide that for you." When I responded that I had not heard of such a policy and asked when his company had initiated it, his reply was, "We just initiated it this morning.... for you."

EVALUATION RESULTS

Apart from the formal evaluation process, we made some general observations during our research period. It appears to us that there are perhaps three tiers of PC clones available today each at a lower price level than the other. The highest tier is perhaps best called an IBM PC "equivalent" rather than a clone and is priced only slightly less than the original. I would put the AT & T product in this category.

The second tier would be those models that are distributed fully assembled by nationally known companies and are a few hundred dollars less than the original. I would put the Tandy 1200, Leading Edge Model D, and Epson Equity I in that tier. These models also seem to get the most exposure in national magazines both in terms of paid advertisements and reviews.

The third tier is composed of those units assembled from a variety of imported parts and generally costing less than $1000. In this category one can assemble his own or buy an assembled unit from an upstart company.

Our PC Faire included models from tier two and pre-assembled units from tier three. We gathered all our data and scheduled an evaluation "showdown." Without identifying specific models in this article (risk management must involve a certain degree of liability avoidance), here is what we found.

The survey responses from Faire attendees ranged from fluff (I like the color of this unit) to good technical comments (Does not allow DOS shell switch except when booted with PC DOS). The negative comments were as important as the positive comments. There were many comments related to ergonomics (monitor flicker, couldn't find the power switch, easy tilt) and to keyboard layouts (footprint, return key size & location). In terms of ranks, a model from tier three came in first with twice the points of a tier two model that came in second. Interestingly, only that one model from tier two (the models with all the publicity) ranked very high.

Mentally filing away that reference point, we looked at the software compatibility load test results. All of the units tested passed the commercial application software load test. So on to the hardware test.

We got a chuckle when we opened the units to insert LAN adapter cards. We found that three of the bottom tier units had the same mother board and several of the disk drives had familiar looking decals on them. To our surprise, some of the tier two units did not (could not? would not?) talk to our local area network. We didn't pursue that further; they either got us a network prompt or they didn't. There was no significant difference in the random read, serial read, and prime number generation (raw cpu power) tests among the units. However, some units from both tiers took four times as long to perform the random write test as did a genuine IBM PC/XT. This seemed to be a function of which manufacturers' disk the vendor had installed. We didn't put a lot of weight on that curious result thinking that PC users probably do more disk reading than writing in an average session.

Lastly, we looked at the ball park prices. In many cases there was little ($30/unit) or no difference in quantity prices between 1 and 100 units. The prices ranged from $850 to $1434 for the 640Kb, dual floppy units with monochrome monitor, expansion slots, and keyboard.

Now it was time to determine what factors would be absolute "killers" in terms of disqualifying any units. We determined that network compatibility was a must for our campus and that eliminated two units. One unit did not have sufficient internal expansion slots and was eliminated. Finally, we decided that if we were really trying to stretch our dollars, we should set $1000 as an upper cost limit disqualifier. Five units from tier three met all the requirements and cost less than $1000.

LET'S GO FOR IT

The next step was to announce our results and begin the actual procurement process. Departments across campus were told of our results and asked to submit requisitions to Purchasing for as many "low-cost IBM PC/XT compatibles" as they wished at $900 each (not knowing what the final bid price would be). Within a week we had requisitions for a total of 105 units.

Meanwhile we composed a list of technical specifications (see Attachment A) primarily based on the unit that had received the highest Faire attendee survey score and the Purchasing Department sent out formal bids. To keep within the $100,000 limit, we excluded printers and enhancement cards from this procurement thus allowing departments to choose their own printers and features based on their unique requirements through normal procurement channels.

When the official bids were received, the winning vendor (you would not recognize the name) offered the product we required at $799/unit plus tax. We ordered 125 units.

WHERE DO WE GO FROM HERE?

The units have arrived and the vendor installed them as part of the contract. We have spare units and spare parts. The users are excited and want to buy more. We've had visits from Big Blue wondering what we're up to and providing us lectures on loyalty, reliability, and subtle hints of future incompatibilities. We think we've been responsible custodians of the State's (shrinking) resources by providing more microcomputer access to students, faculty, and staff with the same dollars. If it is a success, we'll let you know in a follow-up article and, if not, look for a "Don't Buy Clones" article by a different author next year.

PC CLONES AT SFSU: Sixth Month Progress Report

1. As of December 1986, we have acquired about 250 workstations. The initial order order was for slightly over 100 in June 1986.

2. Quite a few users are choosing to order the color monitor option (+ $179) and/or the Seagate 20mb hard disk option (+ $410).

3. Working with the vendor, we've solved two minor problems:
   a) the ROM BIOS would not generate the appropriate characters that Lotus 1-2-3 wanted to see to execute an Abort Macro command so the vendor changed the BIOS chips for us for free, and
   b) the instruction code for initiating the clock was incorrect so the vendor provided correct instructions.

   It is important to note that by having one clone vendor, when we solved one problem, we essentially solved 250 problems.

4. Some users found the floppy disk drives too slow when initiating a new diskette or copying another diskette. We are evaluating a faster disk drive which the vendor is willing to offer those impatient users for a small additional fee.

5. Due to the increasing number of units we are acquiring and their rapidly expiring warranties, we are planning to issue a maintenance contract to the vendor. Essentially, an extended warranty, we plan to swap spares for dead units with our users during the week and have the vendor come one day a week to repair the assembled collection of defective units. We have only three full time technicians to support over 1000 workstations and components on campus.

6. The California State University, Sacramento campus (with six technicians) has chosen to bypass the vendor interface and is acquiring parts and assembling clones from scratch.

7. The California State University, Long Beach campus recently conducted a survey of PC AT clones and has identified the Zenith 248 (full blown @ $2600) as their choice.

APPENDIX A

SPECIFICATIONS

IBM PC Compatible computer with :

640 kilobytes RAM memory.
Motherboard with IBM-PC compatible expansion slots. At least five free expansion slots must remain after all specified options have been inserted.

IBM PC Compatible ROM BIOS.
Dual-speed CPU operation (4.77 and 8 Mhz), switchable from the keyboard.
RS-232-C port, and parallel printer port.
Diskette drive controller with 2 half-height 360-kilobyte 5-1/4" diskette drives.
135 watt (or more) power supply.
Battery backed-up clock/calendar chip.

"Hercules" compatible monochrome text and graphics display adapter.
Monochrome monitor with 14-inch diagonal amber screen and swivel base, Quimax DM-14 or equivalent.
15 Systems to quote without monochrome Monitors and monochrome text and graphics display adapters.
Approximately 34 Systems are to have "flip top" cases, the remainder to have "slide off" cases.
Maxiswitch brand IBM PC XT/AT compatible keyboard.

Systems shall be demonstrated to operate correctly with the following hardware and software:

3Com EtherLink, EtherSeries, and EtherTerm
IBM Color Graphics Adapter
Seagate ST-225 disk drive and controller
Lotus 1-2-3 with Hercules graphics driver
dBase III
Microsoft Word, Multiplan, and Flight Simulator.

It is the intention of the University to purchase units that are 100% compatible with IBM PCs (expecting BASIC ROM compatibility). We reserve the right to test proposed systems with other PC-compatible hardware and software before accepting a system for purchase.

Vendor must provide six month warranty on all components. During this time Vendor will repair or replace (at Vendor's option), on a depot return basis, components identified by SFSU as defective. Vendor shall not be responsible for removal or installation or repaired or replaced components. Average turn around time for components to be repaired or replaced shall be not more than two weeks.

Vendor shall install all systems in their operating location, and verify correct operation with a power-on test of at least two hours on the day of installation. During the first 30 days a system is in service, defective components shall be replaced within two days of their identification as defective.

Please indicate your best delivery, not to exceed 30 days. Any delivery shown must be met.

LINKING MAINFRAMES WITH MICROS FOR REQUEST BUDGET PREPARATION

William L. Tetlow
Vantage Information Products, Inc.
Boulder
Colorado

John Graham
University of Colorado
Boulder
Colorado

Betsy Maguire
University of Colorado
Boulder
Colorado

ABSTRACT

In May 1986, a project was launched and completed to improve the Request Budget procedure at each of the campuses of the University of Colorado. Officials described the former mainframe process for developing request budgets as inadequate, ineffective, and difficult to run. The project entailed extracting data that was maintained in central mainframe computers and downloading it to floppy magnetic diskettes that were preformatted for use with Lotus 1-2-3 and Symphony spreadsheet programs. This permitted the budget officers to reduce, significantly, the amount of manual data entry, calculation, and preparation time for final budget requests. The Budget Office established specifications, the University Office of Management Systems developed the data extraction and downloading procedures, while the development of microcomputer spreadsheet templates, documentation, and end-user training was sub-contracted to Vantage Information Products, Inc. From all perspectives the project was successful because it because an effective team approach was adopted that involved the end user in a very direct and immediate fashion. In addition, the decision to engage an external developer enabled the University to optimize its scarce resources and effect a quality solution in a very short period of time.

A Mid-Eighties Problem

As the personal computer revolution expands and matures, an ever increasing number of end users seek access to data and information that they know is already in machine readable form at mainframe computer installations. Frustration levels of computer center personnel and end users alike are escalating rapidly because resources are limited and shrinking while demand is escalating. "Can't you download the data I need so that we can escape the processing queues and system bottlenecks?" is a refrain that is threatening to surpass the football team's fight song as a campus anthem.

Computer professionals, wary of cloning the sins of the past -lack of security, integrity, documentation, inadequate design, implementation and so forth -are searching for ways to satisfy the demand without sacrificing one iota of quality. Not surprisingly, the solution lies in a cooperative endeavor that involves end users in a significant fashion and which assembles the required expertise from sources both internal and external to the system. This account concerns a successful implementation of a mainframe-micro linkage at the University of Colorado that improved vastly the process of developing the annual request budget for submission to higher authorities.

To fully appreciate the solution we need to provide some background of the budget environment at the University of Colorado, the request budget process and finally, look at the decision to move from a mainframe to a PC. With the dynamics established, we will outline the technical specifics and then describe the major design features of the micro implementation.

Budgeting at the University of Colorado

The University of Colorado is a multicampus, public University with a total enrollment of 40,000 students. Each campus is subject to the policy decisions of a publicly elected Board of Regents and the authority of the Board of Regents is bounded by the Colorado Commission of Higher Education (CCHE). The Commission makes recommendations to a number of Legislative committees, including the Joint Budget committee (JBC). The University of Colorado is unlike many other public universities in that it is subject to a unique legislative "Memorandum of Understanding". This Memorandum stipulates that the Legislature will designate funds for the University as a whole, and the executive arm of the Board of Regents (plus the campus administrators) will allocate these funds to specific programs. As one would expect, this campus-level allocation is subject to extensive and ongoing negotiations. In addition, auxiliary enterprises submit proposed budgets for the upcoming year. Both the budgets for continuing and auxiliary activities and the actual income and expenditures are then summarized in a standard format. This multi-layered decision-making approach lends itself to a "request budget" process.

History of the Request Budget Process

Every year each of the four campus administrations submit a budget proposal to the Board of Regents. The Board considers these proposals in light of the strategic plan of the University. the combined and consolidated University request is then reviewed by CCHE and the request as well as Commission recommendations are finally submitted to the Joint Budget Committee of the state legislature. In general, the process requires the collection and collation of financial and budgetary data by each campus. The actual accounting information data is collected for every Campus account across all University activities. Similarly, budgets for ongoing University activities are "rolled-forward" and incremented for the request year package.

This process of data collection and collation was computerized at the University of Colorado in the late 1960's. It remained substantially unchanged until the summer of 1986. In the late sixties, an outside consultant programmed a package that would collect data from all Financial Reporting System (FRS) accounts, assign each account to specified categories of accounts and copy income and/or expenditures from each account to a file called "Phase0". In a similar fashion, budgetary figures have been categorized and copied to the Phase0 file. These numbers represent the current budget. The current budget figures are then incremented by some anticipated rate of inflation to arrive at preliminary request budget figures for the subsequent year. After the Phase 0 file has been constructed, a copy of the file is printed and reviewed by the Budget Office. Edits are made to correct mistakes in the file construction, to make adjustments arising from negotiations, to add further calculations to the file, and to allocate what are known as "cash funds" to various categories of expenditure. Usually, a number of edit sessions are involved. Eventually, a second file is created , known as "Phasel", that contains data that has been summarized further. Any temporary budget additions or deductions are also included in Phasel. After additional edits, Phasel is printed, published, and distributed for review.

Major Problems with the Existing System

As one might expect, this process has been lengthy and laborious. It is one that is iterative, time consuming and subject to demanding dead-lines. Initial budget edits have usually required several weeks of review and reruns. In addition, the package design has limited the number of functions performed by the computer. Documentation is virtually non-existent. Poor documentation has frustrated both the budget office and data processing personnel. For example, neither staff has been certain which input files should be attached at process start up. Often, a number of runs have been conducted in order to identify and attach the correct files. Each year the budget office staff has also made a very large number of calculations by hand, calculations that should have been performed by the computer. This lengthy and iterative process in conjunction with the decision-making demands has led to a search for an alternative process.

Decision to develop a PC-based request budget

Initially the Office of Management Systems (OMS) was approached by the Budget Office and asked to develop a new computerized process to alleviate problems mentioned earlier. Decision-makers required timely information when data retrieval and summarization was time-consuming and sometimes unreliable. The preliminary idea was to develop an on-line system. This system would enable needed changes to be made dynamically and reduce, by a substantial factor, the overall time to complete the process.

OMS examined the Budget Office request and asked basic questions:

What system would enable the most immediate and flexible access by the Budget Office to request budget data?

What technologies were available to build such a system?

How could OMS best utilize its development staff?

How could OMS best allocate its computer and staff resources and those of the Budget Office?

A set of evaluation criteria was established and used to select the best solution among a number of alternatives. The result of this inquiry was the recommendation that a personal computer based request budget program be developed using personal computer spreadsheet technology. Essentially, a Phase0/Phase1 file was to be constructed on the mainframe and downloaded to a 5 and 1/4 inch floppy diskette. This data file would then become the input file for a Lotus spreadsheet template. Edits would then be made directly to the Phase0/Phase1 data now contained in the template, additional allocation and FTE calculations would be performed by the computer, and a thorough documentation would facilitate start-up and overall execution of the request budget process. The resultant file would be downloaded from a mainframe to a PC diskette and provide the initial data for loading into a Lotus template. The Budget Office staff could then manipulate the data as frequently and whenever desired using Lotus.

Advantages of a Mainframe/Micro Solution

The Budget Office was already familiar with Lotus. Thus, they could immediately make required edits with minimal additional training. Lotus would also be a much more effective vehicle for edits than the previous system of manual calculations and multiple iterations of mainframe processing. Further, OMS would require a single staff person to restructure existing files for downloading, and they could readily contract an outside firm to develop the Lotus template. By sub-contracting the construction of the Lotus template to a skilled and experienced outside developer the OMS could significantly reduce the development time and incorporate state-of-the-art features in the resulting system. In addition, OMS would conserve its computer processing resources, rely on the Budget Office staff using their microcomputers to make necessary edits and calculations. Additionally, OMS had recently acquired and tested a number of downloading packages. This option would represent an ideal first application for the selected download and permit implementation of the overall project with comparative ease. Finally, the requisite resources were available to execute the project and develop a real-time system.

Assembling An Expert Team

Once this recommendation for a PC-based solution was accepted, a team of three people was assembled. One represented the Budget Office, drew up budget specifications and acted as a liaison with OMS and the external contractor. The second person, a senior systems analyst from the university Office of Management Systems (OMS) developed the download file. The third team member represented Vantage Information Products, Inc. (VIP) - a subsidiary of the National Center for Higher Education Management Systems (NCHEMS). VIP built the Lotus template, wrote the documentation, and provided training and assistance to the Budget Office staff users. The Director of OMS assumed responsibility for overall project coordination.

Technical Details of the Budget Data Assembly

The first step of the Request Budget processing is performed on an IBM 4381 using COBOL. It matches the "actual year" dollar information from the Subsidiary Ledger file in the Financial Reporting System (FRS) with the continuing dollar and full-time-equivalent (FTE) budgets from the Budget file in the single entry Budget System. Increment tables provided by the campus budget offices are then used to derive projected dollars and FTE budgets for the "request year".

To understand the extraction process it is necessary to have a some technical information on the source of the data. The FRS subsidiary ledger file is a Virtual Access Storage Method (VSAM) file which contains dollar and attribute information for accounts, or budget units, that are used by the departments. Each 7-digit account is further defined by a 3-digit object code with specific object codes reserved for budget pools. Each budget pool relates to specific expense or revenue object codes which are similar in nature (e.g. office supplies, travel, etc.) The relationship of budget pools and object codes has been predefined in the system.

The Subsidiary Ledger File also contains attribute information needed for the request budget. The request budget uses two of these attributes, the State Budget Format (SBF) code and the line number. The State Budget Format code is an attribute established at the time the a 7-digit account is created and is used to identify the state schedule to which an account relates. The line number is an attribute associated with a 10-digit account. It is updated weekly using the SBF for the 7-digit account, the budget pool, the detailed object codes, and tables maintained by the Central Finance Office.

The Single Entry Budget System is an online system which provides entry of all budget data, including base amounts and FTE budgets, continuing and temporary budget revisions, temporary reallocations, and position information. It is maintained by the Campus Budget Offices. The budget pool record used in the Request Budget contains budget data by FRS object code for each Subsidiary Ledger account with a budget or an expenditure. The Request Budget is only concerned with those budgets that are carried forward to the next fiscal year. The continuing budgets are rolled forward automatically to the next year for state funded accounts. When the Budget Offices have entered all of the revisions, a backup tape file is frozen for the Phase0 run.

The third source of input information is a set of tables provided by the Campus Budget Offices. One is the Standard Request Year Increments with increase percentages by budget pool within campus; a second contains other major adjustments. The third table is a line number table of required line numbers within State Budget Format with a description used for reporting purposes only. The last source of input data is miscellaneous tables and files already established in the Financial Reporting System. These tables files are used to determine the State Budget Format and line numbers for accounts that are not established on the previous fiscal year FRS and to derive actual FTE from the FRS dollar amounts. The first program on the mainframe produces two reports and a summary file. The first report (Phase0) displays three sets of columns of data. The first column is the actual dollar amount expended in the prior fiscal year; it is derived from the FRS subsidiary ledger file. The second set of columns is the continuing dollar and FTE budgets from the current year ("estimated"). These data are from the "frozen" budget file. The third set of columns is the "request" year data which is projected by multiplying the estimated year dollars by prescribed increase factors provided by the Budget Office and by adding or deducting special amounts provided. Totals for all columns are by line number and State Budget Format. The second report is the same three sets of columns of dollar and FTE data included in the Phase0 report summarized to line number within SBF.

The Download Procedure

A summary file containing one record for each line is produced at the time the previous mainframe reports are run. This summary file is reformatted to an output file using a second mainframe program. In this program the EBCDIC numerics are reformatted to ASCII numerics, each field is separated by a delimiter, and state budget formats and line numbers can be reassigned. The output file is then ready to be downloaded to a 360Kb PC floppy disk using Virtual Disk Access Method (VDAM), a file transfer software package from Phaser Systems. VDAM runs under IBM's OS/MVS operating system with Advanced communications Function for Virtual Telecommunications Access Method (ACF/VTAM). VDAM and a resident terminal emulator program -the University of Colorado is currently using IRMA -allow the PC and the mainframe, or host computer to communicate with each other and share files.

Once a user is signed on to VTAM and VDAM a virtual disk drive can be created and mounted on the mainframe, or host computer using VDAM. Then VDAM allocates blocks of direct access storage spaces to create a VSAM file. Although this VSAM file acts like a floppy disk attached to the PC, it is not a "real" disk. Therefore VDAM has called it a virtual floppy or fixed disk, or VFD. It can be accessed by both the PC and the host computer. The PC user is allowed to move, or "capture", a held output file to an OS sequential dataset or a partitioned dataset member on the host computer. The University of Colorado has created one sequential dataset to be used for all downloading. At the time the host job is captured it can be deleted automatically from the held output queue, freeing up resources on the output spool. This captured output file can then be moved from the OS dataset to the VFD created with VDAM. Now the VFD can used as if it were a extra floppy disk for the PC. Using the DOS copy command it can be copied to another floppy disk. At the end of processing it is necessary to dismount the virtual floppy disk and sign off to VDAM and to VTAM.

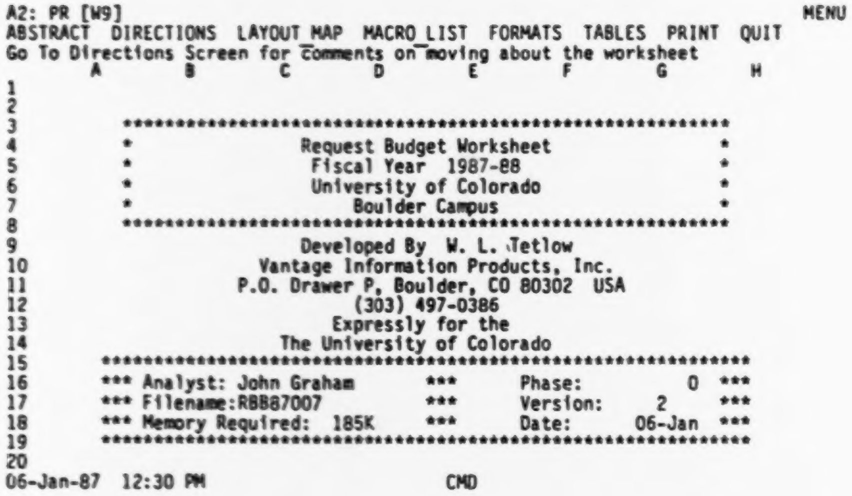
Although VDAM has uploading as well as downloading functions, the University of Colorado has limited its use to downloading for security and file integrity reasons. For space management the use of a held output file which is deleted from the output spool after the downloading process is complete was selected because one OS sequential file can be used instead of many files created for each user. Currently the Request Budget process is the only procedure using the downloading function but there are many potential applications. Users that are currently hand entering data into LOTUS spreadsheets using data from mainframe files are anxious to use the downloading process of VDAM. The major problem facing them is how to get their EBCDIC numerics used on the IBM mainframe converted to ASCII numerics used by LOTUS and other software.

Micro Implementation Design Considerations

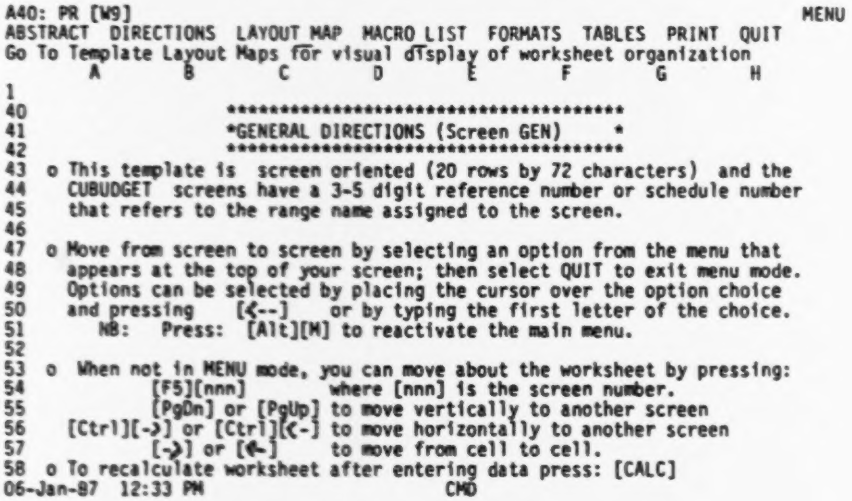
For the Budget Office staff use both spreadsheet and database software were considered. The Lotus spreadsheet (all 1-2-3 and Symphony versions) was ultimately chosen for several reasons. First, the spreadsheet metaphor was familiar to most end users whereas database structures and procedures were considered the domain of computer specialists. Second, the users needed the ability to make modifications themselves in a relatively "clear-box" environment rather than in the more arcane "black box" that is the normal user perception of computing. The capability for the end user to examine directly the formulas and inter-relationships - in essence, the source code - is the feature that has made the electronic spreadsheet the "manager's programming language". In excess of four million users have some fluency with Lotus 1-2-3; a statistic that few other languages can begin to approach. This decision was not taken lightly, however, because spreadsheets do not permit much error trapping to be built into the application. Consequently more attention had to be placed on logical design so that errors would be very evident.

To organize the spreadsheet it was structured in a reference "screen grid" design. Since a personal computer screen can display 20 spreadsheet rows at one time (19 for DEC and HP) and 72 characters per line that became our grid unit. The final template consisted of approximately 100 screens each displaying a maximum of about 1K of data and labels. It was decided to make the screen image conform as much as possible to the state budget forms so that the users would feel more comfortable with the technology. The user would thus be filling in an electronic form rather than entering data into a special input area. The spreadsheet was "locked" against accidental overwriting and user input cells - 99% data - were highlighted.

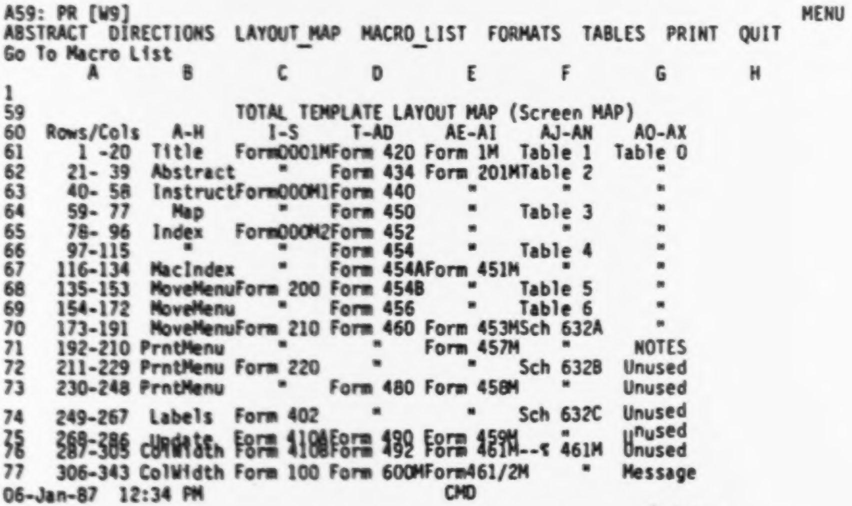
Users could modify any label or formula, however, by deliberately "unprotecting" a cell to make changes. To maximize user convenience and access, macros - preprogrammed Lotus command routines - were used extensively. Users were given several options for moving about the template with the default option being menu selection. Custom menus are themselves a special form of Lotus macro programming and menus were chained and cross-linked extensively. To accommodate a need to display a data form that always contained more than 72 characters several columns of data were controlled by special display macros. The user could opt to have any two of the three data sets displayed at one time. Special print macros, selected by menu, controlled the expansion of the data sets immediately prior to printing and obtained the necessary header and footer labels. To compensate for the inevitable "mis-execution" by a user an "OOPS macro" was also established to reset all parameters to default states.



```
A2: PR [W9]                                                                 MENU
ABSTRACT  DIRECTIONS  LAYOUT_MAP  MACRO_LIST  FORMATS  TABLES  PRINT  QUIT
Go To Directions Screen for comments on moving about the worksheet
        A         B         C         D         E         F         G         H
1
2
3           *********************************************************
4           *                 Request Budget Worksheet              *
5           *                  Fiscal Year  1987-88                 *
6           *                University of Colorado                 *
7           *                    Boulder Campus                     *
8           *********************************************************
9                           Developed By  W. L. Tetlow
10                      Vantage Information Products, Inc.
11                    P.O. Drawer P, Boulder, CO 80302  USA
12                               (303) 497-0386
13                              Expressly for the
14                          The University of Colorado
15        *************************************************************
16        *** Analyst: John Graham        ***      Phase:          0  ***
17        *** Filename:RBB87007           ***      Version:     2     ***
18        *** Memory Required:  185K      ***      Date:      06-Jan  ***
19        *************************************************************
20
06-Jan-87  12:30 PM                        CMD
```



```
A40: PR [W9]                                                                MENU
ABSTRACT  DIRECTIONS  LAYOUT_MAP  MACRO_LIST  FORMATS  TABLES  PRINT  QUIT
Go To Template Layout Maps for visual display of worksheet organization
        A         B         C         D         E         F         G         H
1
40                    **************************************
41                    *GENERAL DIRECTIONS (Screen GEN)     *
42                    **************************************
43  o This template is  screen oriented (20 rows by 72 characters)  and the
44    CUBUDGET  screens have a 3-5 digit reference number or schedule number
45    that refers to the range name assigned to the screen.
46
47  o Move from screen to screen by selecting an option from the menu that
48    appears at the top of your screen; then select QUIT to exit menu mode.
49    Options can be selected by placing the cursor over the option choice
50    and pressing    [<--]    or by typing the first letter of the choice.
51       NB:   Press:  [Alt][M] to reactivate the main menu.
52
53  o  When not in MENU mode, you can move about the worksheet by pressing:
54            [F5][nnn]         where [nnn] is the screen number.
55            [PgDn] or [PgUp] to move vertically to another screen
56    [Ctrl][->] or [Ctrl][<-] to move horizontally to another screen
57              [->] or [<-]     to move from cell to cell.
58  o To recalculate worksheet after entering data press: [CALC]
06-Jan-87  12:33 PM                        CMD
```



```
A59: PR [W9]                                                                MENU
ABSTRACT  DIRECTIONS  LAYOUT_MAP  MACRO_LIST  FORMATS  TABLES  PRINT  QUIT
Go To Macro List
        A         B         C         D         E         F         G         H
1
59                     TOTAL TEMPLATE LAYOUT MAP (Screen MAP)
60  Rows/Cols   A-H      I-S      T-AD     AE-AI    AJ-AN    AO-AX
61     1 -20  Title    Form0001MForm 420 Form 1M  Table 1  Table 0
62    21- 39  Abstract    "     Form 434 Form 201MTable 2      "
63    40- 58  InstructForm000M1Form 440     "        "         "
64    59- 77    Map       "     Form 450     "    Table 3      "
65    78- 96  Index    Form000M2Form 452     "        "        "
66    97-115    "         "     Form 454     "    Table 4      "
67   116-134  MacIndex    "     Form 454AForm 451M    "        "
68   135-153  MoveMenuForm 200 Form 454B    "    Table 5      "
69   154-172  MoveMenu    "     Form 456     "    Table 6      "
70   173-191  MoveMenuForm 210 Form 460 Form 453MSch 632A      "
71   192-210 PrntMenu     "        "    Form 457M    "      NOTES
72   211-229 PrntMenu Form 220     "         "    Sch 632B  Unused
73   230-248 PrntMenu     "    Form 480 Form 458M    "      Unused
74   249-267  Labels  Form 402     "         "    Sch 632C  Unused
75   268-286  Update  Form 410AForm 490 Form 459M    "      Unused
76   287-305 ColWidth Form 410BForm 492 Form 461M--< 461M   Unused
77   306-343 ColWidth Form 100 Form 600MForm461/2M    "     Message
06-Jan-87  12:34 PM                        CMD
```

```
A116: PR [W9]                                                                MENU
ABSTRACT  DIRECTIONS  LAYOUT_MAP  MACRO_LIST  FORMATS  TABLES  PRINT  QUIT
Go to Menu Selections for Budget Formats
        A         B         C         D         E         F         G         H
1
116                       ***************************************
117                       *       MACRO INDEX  (Screen MAC)       *
118                       ***************************************
119                        Keystroke  Range        Menus
120                        ---------  ---------    -----
121                        [Alt][A]     \A       ACTUAL and ESTIMATE year settings
122                        [Alt][E]     \E       ESTIMATE and REQUEST year settings
123                        [Alt][F]     \F       FORMATS Menu
124                        [Alt][L]     \L       LOAD Phase0 Data
125                        [Alt][M]     \M       MAIN MENU
126                        [Alt][O]     \O       OOPST Macro - restore ALL col widt
127                        [Alt][P]     \P       PRINT Menus
128                        [Alt][R]     \R       REQUEST Year and RECCOMEND setting
129                        [Alt][T]     \T       TABLES Menu
130                        [Alt][U]     \U       UPDATE column headers
131               --------------------- Macros -------------------------
132 [Alt][A] [Alt][E] [Alt][F] [Alt][L] [Alt][M] [Alt][P] [Alt][R] [Alt][T]
133  ACTUAL   ESTIMATE Formats  Load Pha Main Men Print Me REQUEST  Tables M
134  XGaseth   XGeset  /xmFORMAT GOTO 'ab/xmMAIN_M/xmPRINT_ XGrseth /xmTABLES
06-Jan-87  12:48 PM                               CMD
```

```
A78: U [W9]                                                                  MENU
Form 100  200 Series  400 Series  Series M  MAIN_MENU  QUIT
Format 100
        A         B         C         D         E         F         G         H
1
78             INDEX              Screen #  Formats:                  Screen #
79    Abstract .................    ABS       Library Staffing Recc       457M
80    Alphabetical Screen Index     IND       Library Acquisitions        458M
81    Formats:                                Library Unit Equivalent     459M
82      Academic Support-Librar    456        Other Inst'l Coll. Inc      210
83      Admin Formula for 450 .    451M       Other Inst'l Inc & Exp.     600M
84      Capital Outlay.........    480        Physical Plant Formula      462M
85      Cash and Fed Funds -Act    632a       Public Service..........    434
86      Cash and Fed Funds -Est    632b       Rentals-Bldgs. & Land .     490
87      Cash and Fed Funds -Req    632c       Resident Instruction...     402
88      Computing Support CADPC    454A       Special Sub-Programs...     410
89      Computing Support ACS .    454B       Student Services ......     452
90      Computing Support Total    454        Student Services Formul     453M
91      Enrollments ...........    100        Summary-Budget Request     0001M
92      Extraordinary Items....    492        Summary-Sponsored & Int    000M1
93      General Fund Income....    220        Summary-Stdnt/Tuit/Fac     000M2
94      General Information ...     1M        Tuition Income Projectn     201M
95      Institutional Support..    450        Utilities .............     461M
96           QUIT menu and [PgDn] for continuation of Index
06-Jan-87  12:49 PM                               CMD
```

```
I306: PR [W1]                                                                MENU
Form 100  200 Series  400 Series  Series M  MAIN_MENU  QUIT
Format 100
    I        J          KLM     N            O            P            Q      RS
1
306                            Actual    1985-86     Estimate     1986-87
307  Format 100             HS Headcount  Student Cred Headcount  Student CredHS
308  Enrollments             - ---------------------  --------------------- -
309   Instruction: General Academic by Term and Student Level
310  SUMMER:
311    Graduate Resident***        1,316       5,721        1,142        6,459 **
312               Non-Res***         292       1,233          313        1,977 **
313    Undergraduate Res***        3,147      19,194        3,154       17,952 **
314               Non-Res***       1,326       8,340        1,439        8,436 **
315  FALL:
316    Graduate Resident***        3,174      25,440        2,997       24,038 **
317               Non-Res***       1,025       9,423          982        9,021 **
318    Undergraduate Res***       12,528     175,938       12,338      173,227 **
319               Non-Res***       6,040      87,420        6,003       86,868 **
320  WINTER:
321    Graduate Resident**             0                        0              *
322               Non-Res**            0                        0              *
323    Undergraduate Res**             0                        0              *
324               Non-Res**            0                        0              *
06-Jan-87  12:50 PM                               CMD
```

Documentation and Training

Prior experience with developing documentation for end users led VIP to keep print documentation to a minimum. Readers seldom consult the manuals and almost always wait until they do not know how to proceed. The design of the menus, and the on-screen documentation were thus intended to solve that problem. Training of budget office staff was planned from the start of the project. Although group sessions were considered, the logistics of the situation made it more logical to train one primary user in each location in a personalized "one-on-one" basis. Telephone support was provided "on demand" and proved to be very effective in solving 80-90% of the problems. Users could be talked through the process and make corrections on the spot.

"The Bottom Line"

The ultimate test is to ask the question "If you had it to do over again would you do it the same way?" The development of the personal computer request budget template was rather complex, requiring a large number of design decisions. Crucial to the successful development of this package was ongoing, informal communications. Every team member had immediate access to the other, and everyone was free to ask questions and make suggestions throughout the project. From the perspective of all participants this project was accepted and completed in only ninety days because an effective team approach was adopted that involved the end user in a very direct and immediate fashion. In addition, the decision to engage an external developer enabled the University to optimize its scarce resources and effect a quality solution in a very short period of time.

MIGRATION OF HOST COMPUTING TO MICROCOMPUTER PROCESSING AT BENTLEY COLLEGE

Thomas Maggiacomo

Bentley College

Waltham

Massachusetts

This paper describes the Bentley College migration from a highly centralized host computer-oriented environment to our current mixture of microcomputer and host computer, and the problems encountered distributing information from a centralized subject data base to a microcomputer environment. The planned evolution from an environment consisting of host computing, communication servers, file servers, and microcomputers to one of a centralized processor, departmental processors, and microcomputers will be described. Anticipated problems of connectivity, data base synchronization, universal dictionaries, hardware, security, data administration, and software will also be discussed.

I. OVERVIEW

Historically, most data processing resource plans are the result of tedious capacity planning sessions involving estimated user, application, and hardware growth. Then a quest for a computer that will satisfy the requirements is started. Usually, it is the next biggest computer that the vendor makes. After much haggling by management over costs, the upgrade is made and everyone is happy for some period until the demand again exceeds the supply, and the process is started all over again.

This paper illustrates a different approach for providing adequate computing resources for the administrative offices of Bentley College. It is an evolution from a highly centralized computing environment to one of departmental computing, yet retaining the advantages of centralized information.

It will trace the evolution of Bentley administrative computing from a centralized host computer to terminal environment, to a phase of centralized host computer to terminals and microcomputers with intervening file and communication servers, to a desired environment of centralized host computer networked with departmental computers serving terminals and microcomputers of individual departments.

Bentley College is fortunate in having a truly centralized "subject" data base, and the software and hardware which supports this type of data base, the Prime Information computer. A subject data base is one in which there is no redundant data. For example, a person's name appears only once in the data base and is available in its most current form to all the offices of the College. Many schools and businesses desire this type of data base, but few obtain it. There are, however, technological and procedural problems that must be overcome if we are to retain this type of data base with our desired environment of departmental computing. These problems and possible solutions will be described later in the plan.

II. INITIAL ENVIRONMENT

When Administrative Systems started using the Prime computer, the configuration was that of a typical centralized computer system (see Figure 1). This consisted of the Prime computer connected to the terminals through wires attached directly to the terminals and a front-end communications processor (Micom) and then to the computer. If the computer or the front-end communications processor went down, all users were without computer service.

The initial computer was a Prime model 850, which was upgraded to the present model 9950 in January 1984.

The system software was Prime INFORMATION running under PRIMOS.

INITIAL ENVIRONMENT - PHASE I

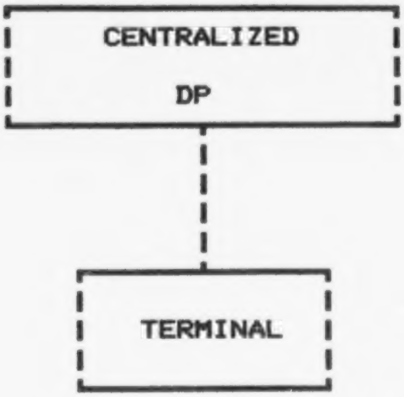

CENTRALIZED
DP
TERMINAL

FIGURE 1

The application software was the Academic Institutional Management System (AIMS) package which had been purchased from AXXESS. An existing Work Order/Inventory system was converted from the DEC version of the program to the Prime computer and was written in Cobol; all other programs were written in INFO/BASIC.

In a relatively short time period (August 1982 through September 1984), modules of the AIMS package were implemented to provide computer services to the Registrar, Admissions, Alumni, Development, Financial Aid, Student Housing, Accounts Receivables, General Ledger, Fixed Assets, and General Mail.

Major enhancements to the existing modules and additional customized modules were added later to provide computer services to Purchasing, Accounts Payables, Campus Police, Student Affairs, Continuing Education, Evening Division, and the Graduate and Undergraduate Schools.

The basic goal of this environment was to provide a reliable, workable, integrated administrative computer system, and provide at least basic computer service to as much of the College as possible in the least amount of time.

III. PRESENT ENVIRONMENT

The present Prime 9950 computer was installed at Bentley Cllege in January 1984. Since that time, usage of the computer has increased dramatically. Listed below are a few factors which show this rapid growth over a 14-month period:

FACTOR	MARCH 1985	MAY 1986
AVG. NO. OF CONCURRENT TASKS	50	85
TOTAL NO. OF USERS	182	254
AVG. CPU UTILIZATION	43%	78%*
NO. RECORDS ACCESSED/HOUR	643,851	1,369,599
TOTAL CPU SECONDS/MONTH	771,824	1,127,305
TERMINALS AND PRINTERS	93	124

*Because of the architecture of a virtual computer, Central Processing Unit (CPU) utilization never reaches 100 percent. 75-85 percent is maximum CPU utilization for this computer.

In February 1985, a planning session was held with representatives of the administrative departments and the Administrative Systems staff to develop a two-year computer plan. One of the goals set by the department as a result of this session was to provide microcomputer resources to the administrative offices, with the objectives of providing word processing, spreadsheeting, secondary processing capability, and host to microcomputer download capability.

The objectives with respect to the computer center were to offload some of the processing load and relieve the host from the heavy and increasing word processing load that it is performing. Additionally, it would give the users independence with respect to the Prime computer in obtaining solutions to some of the minor application needs.

There are presently over 60 microcomputers in the administrative offices. Some of these microcomputers are connected to the host computer through an local area network (LAN), and a few are attached to a file server. With this configuration, we have entered the second phase of our evolution shown in Figure 4. The microcomputers are a mixture of IBM XTs and Hewlett Packard Vectras (IBM AT compatibles).

In addition, most of the 125 terminals are connected through a LAN to the Prime model 9950 host computer. Figure 2 shows the current phase of the evolution.

The system software is still Prime INFORMATION running under PRIMOS. Of course, several newer releases have been installed since the initial installation. The microcomputers are using MSDOS as the operating system.

The application software on the host is still AIMS, with many enhancements and customized modules. Other administrative offices now serviced include Office of Career Planning and Placement, Office of Student Counseling and Development, Adult Referral and Information Center, Computer Equipment Inventory, Library, Public Affairs, and Student Activities.

The administrative microcomputers are issued with WordPerfect and LOTUS 1-2-3 as word processing and spreadsheet software, respectively. Several of the departments have REVELATION running on their microcomputers and use it to download data from the host. REVELATION is a Pick system very similar to Prime INFORMATION, and can also be used as a standalone data base system on the microcomputer. A few of the microcomputers are connected together using Ungermann-Bass Net/One giving them access to a file server. An electronic mail system (The Network Courier) is also available to these microcomputers.

Some technological problems have occurred using the download software that has limited the expansion of this facility to other microcomputers. There is a communication problem that occasionally loses records being downloaded. Modifications had to be made to the host download program to allow individual

CURRENT ENVIRONMENT - PHASE II

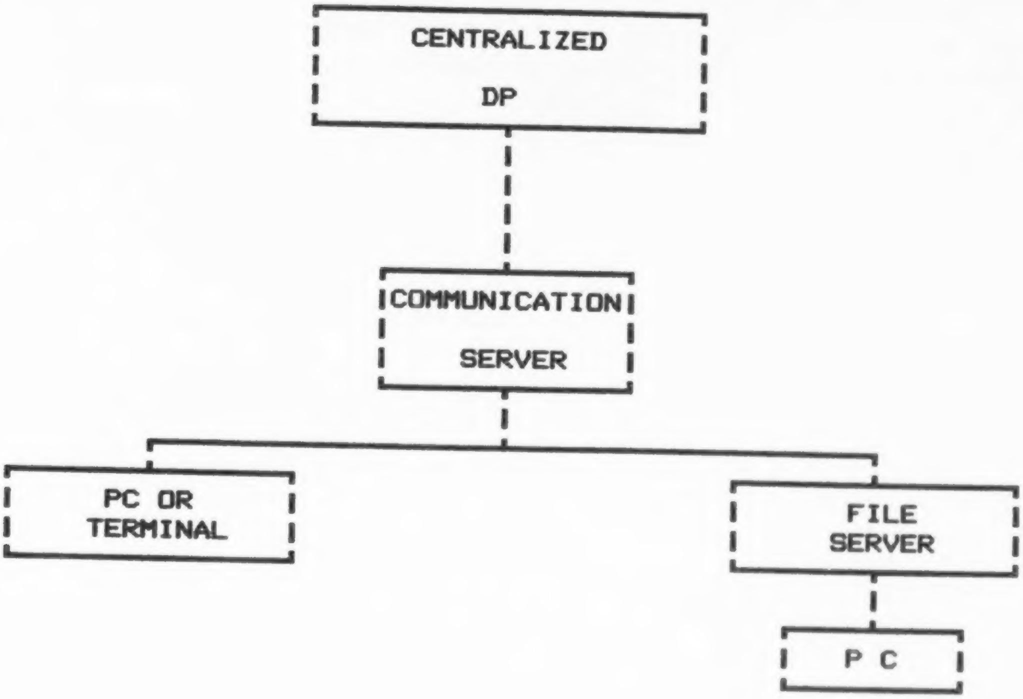

CENTRALIZED
DP
COMMUNICATION
SERVER
PC OR
TERMINAL
FILE
SERVER
P C

FIGURE 2

fields of a record to be downloaded rather than the entire record. Modifications were also made to the host download program to provide an audit trail of the downloaded records. Other software is being researched in the hope that something can be found that will solve these problems.

Dramatic growth of AIMS users and systems has caused performance problems of the centralized host computer. Since many technological problems have to be solved before the next phase of the plan can be implemented, an interim upgrade of the computer must occur. The present environment will be expanded to introduce more microcomputers to the network for the next year or so, at which time we will have reached maturity with this phase of our evolution and will be ready to enter the desired environment.

IV. FUTURE ENVIRONMENT

As the number of microcomputers and the processing demands of the College's administrative offices grow, our current computer environment will not be able to keep pace with these demands. In about a year's time, we will have individual departments that will have processing demands that will warrant their own computer.

Since we do not want to abandon the advantages of the centralized data base structure we have now, it will be necessary to provide access to the data base and still give them the processing power they need. This is where the concept of departmental computing comes in (see Figure 3).

This environment will require drastic changes in the way we will provide computer resources. Essentially, the central computer will become a super file server, security enforcer, and depository for the universal directory.

As a super file server, it will be required to provide access to the data base data for the requesting departmental computers. The key elements to this function will be a high-speed method of data transfer, and a universal dictionary. The high-speed data transfer will be supplied by the LAN. The network now takes on a greater importance, as the central computer becomes just another node in the network, albeit an important node. Survival of the network becomes more important than survival of the central computer, as without the central computer some processing can be accomplished (assuming that one of the departmental computers assumes the file server role), but without the network there is no access to the data.

PLANNED ENVIRONMENT - PHASE III

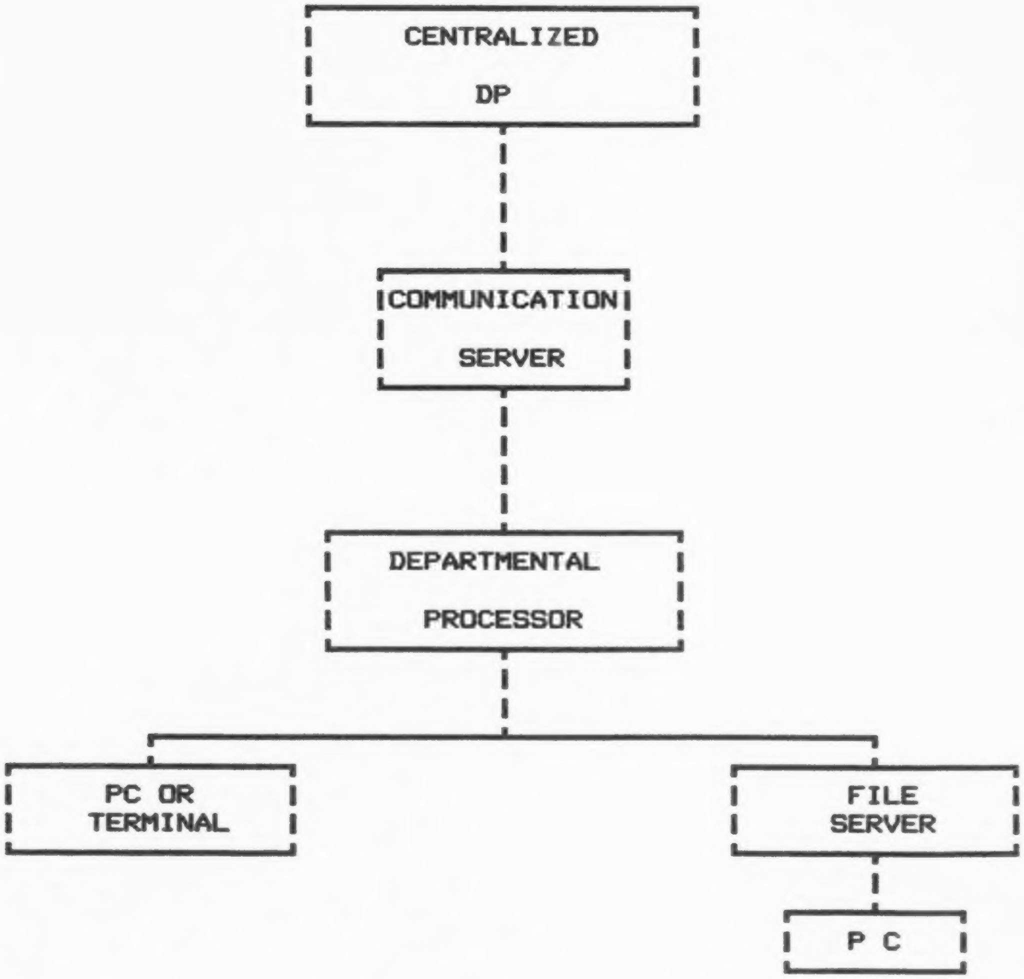

CENTRALIZED DP
COMMUNICATION SERVER
DEPARTMENTAL PROCESSOR
PC OR TERMINAL
FILE SERVER
P C

FIGURE 3

The universal dictionary is also a major key element as it will provide the location of the requested data, and will figure predominately in the security of the system.

Good software is essential in this environment. The operating system, network, and application software become more tightly integrated. The operating system of the central computer must now deal with the operating systems of the departmental computers, and such things as synchronization of internal buffers and cache become critical for data integrity.

Network management software is critical also because the data is flowing throughout the system, and things such as location and health of the network nodes, transaction volumes, and usage statistics become very important for maintenance and planning purposes.

The functionality of the AIMS software will remain relatively the same, but emphasis will shift from providing information to collecting information that will be delivered to user departments for processing on microcomputers at their location. In this way, the AIMS package will be the vehicle to input data into the centralized data base.

For departments whose processing demands exceed the capacities of a microcomputer and require a more powerful minicomputer, major modifications to the AIMS software must be made to enable these departments to run subsets of the package on their computers. This arrangement has some nice advantages in that overall system security is enhanced because the department cannot access other modules even if they could bypass the system security, as the modules do not reside on their computer, and the operating efficiency is increased with the smaller application subset.

V. CONCLUSION

For Bentley College to remain in the forefront of administrative computing, it is necessary that a long-range plan be implemented. This plan basically consists of two steps. The first is a required upgrade to the present computer to be able to satisfy the present and short-term computer demands. The second and most difficult step is to proceed toward departmental computing. This step will require solutions to several complex technical problems. However, the result will be a computer system that will be affected less by performance problems and less expensive incrementally.

ELECTRONIC STUDENT FOLDERS

Robert D. Adams
David Mannering

THE UNIVERSITY OF KANSAS

Lawrence, Kansas

As more and more universities adopt automated systems for tracking a student's progress toward a degree, it becomes important to assess the whole system of student record keeping and processing.

One traditional distribution of academic information has been to keep the student's transcript on a central mainframe database while petitions, and other exceptions remain in paper files. In this state the student record does not lend itself to machine processing.

The University of Kansas has adopted the principle that all academic information on a student is to be contained in the student's transcript. Further, this information is to be coded in a standardized format so that computer programs can accurately process the entire academic record.

The types of processing performed on the student record by various schools within the university may vary. Thus the student record is made available on a read-only basis to administrative microcomputers for specialized processing.

KU's Academic Records Tracking System provides examples of the procedural and technical issues that arise when implementing an automated system under this principle.

Electronic Student Folders

The phrase "graduation requirements" is simple and well understood. Simple and well understood until one attempts to evaluate the record of a student who has been at two or three schools and has changed his intended degree two or three times. We have all experienced this difficulty in evaluating a student's record. Most often we have a staff who have been in place for a number of years and understand, or should I say have assumed they understand, what the intention of the original requirements were. In most cases, these are written but in a number of cases the intentions are part of the folklore of the individual school. With the availability of computing power in big and little packages all of us have thought at one time or another of turning over this tedious "graduation check" task to a machine. Then we start the difficult task, the algorithms for implementing the folklore which has built up through the years. The grandfather clauses, the accepted exceptions, the "we do it this way" and other idiosyncrasies.

We soon realize that many of the idiosyncrasies and exceptions are small pieces of paper and notations in what is most likely called at all schools, a student's confidential folder. What we want to describe in this paper is how we took such a system at the College of Liberal Arts and Sciences at the University of Kansas and are transferring it to a computerized system. We are still in the transition process which will take some time to complete. We want to describe to you a little of the history of the process and the underlining principles which we have adopted and the transition to a new system.

Let me start by describing the "old" system. There are two parts to the student's record in the old system. The student's transcript and what is nominally called the student's confidential folder.

The student's transcript is kept in two forms. The official record is a paper record kept in the Registrar's office. A second record, which is essentially equivalent to the official paper record, is kept on the Student Record Information System database in the main administrative computer. Until recently, the student database transcript did not contain all of the material on the paper transcript. In particular, correspondence courses were kept only on the paper transcript. This has been corrected so that all of the information that is on the paper record is presently contained on the student data base. Unfortunately, some courses such as courses transferred from other universities, CLEP courses and other special types of nonstandard university courses are not in machine readable form. This means that the discipline in which the course belongs is noted in the course number section of the data base but a course number is not included. The information on the specifics of the course is contained in the course description. Although this course description is standardized such a mechanism does not lend itself easily to a machine based system. In fact, a university-wide system or philosophy was not in place until recently to prescribe how these courses should be placed on the student data base.

The second part of the student's record was the student's confidential folder which was kept -- in a filing cabinet -- in the school in which he was enrolled. If, for example, a student changed schools from the College of Liberal Arts and Sciences to the School of Business, the School of Business would produce a new confidential folder for the student. The initial school, in this case the College of Liberal Arts and Sciences, would keep the folder. It is easy to see that a student may end up with several confidential folders with those pieces of information which pertain to the particular school in which he was currently enrolled but failed to indicate the specifics with regards to his progress in the other schools. Although this was not a significant difficulty, one can easily see that it would be a source of confusion. Examples are easy to note. If a student received an exemption from the beginning English requirement in the College of Liberal Arts and Sciences, in a transfer to a School of Business which has a similar requirement this exemption might not be carried forward. Other modifications through petitions or other mechanism of the student's degree requirements are kept in this confidential folder. Since this confidential folder is furnished to the student every semester for advising purposes the security of the folders in any sense was nil. In fact, the return of folders to the central file was not guaranteed and caused considerable difficulty.

Problems related with this are obvious but let me review them very quickly. Since the student's progress was updated manually this was a relatively slow process. Once a year was the minimum. In some cases a student would have his folder updated more often but clearly the probability of a students progress towards degree being correct at the time he received his folder was unlikely. Much of this updating was done by student help and student help turnover guaranteed that there would be difficulty in maintaining the accuracy of these folders. A loss of a folder and the contained records would be a significant loss. This is especially true of information such as approved petitions, special exemptions and what have you.

An alternative to the single confidential folder would be to keep two folders -- one to be retained by the central office and the other issued to the student. This duplication of record has a cost. In the College of Liberal Arts and Sciences, the cost of maintaining such duplicate folders was considered prohibitive.

In providing an automated "graduation check," which would provide updated information to the student with regards to his progress, the folder was a key issue. The challenge is getting all academic information on a student in machine readable form so that a student's progress could be determined automatically. Part of the difficulty is quite clear, courses which are not in machine readable form should be placed in machine readable form. A system must be adopted to code these in a mnemonic way so that both the machine and people can read the course number. The code should reflect the relationship of a course to the students progress towards graduation. Including all of the information on petitions, special exemptions and what have you, in machine readable form was more difficult. In any event, our considerations at this point lead us to adopt three primary principles:

I. All academic information, including petitions and any special exemptions, must be contained on the student data base.

II. The present structure of the data base could not be changed.

III. Only the Registrar and their authorized representatives could update the student data base.

Principle II emerged because the administration felt that it would be too expensive to modify a number of their programs and therefore that we should accept the present structure of the data base. This was accepted. These basic principles led us to a number of developments which we will describe below. The point of this paper is that even though one has a computer program to process machine readable student records, there are many other problems which must be faced prior to the adoption of such a system.

We will address below how we answered these questions in the College of Liberal Arts and Sciences. A second question which arose at the time when we initiated the study of this system, was a choice of machine -- mainframe, mini, or micro. The mainframe is obviously easier but it was not clear at the time we were considering options when the mainframe programming could be done. At the other extreme it was not clear that a micro computer had sufficient memory or speed to take care of a school with 12,000 to 13,000 students.

Nevertheless, we decided to explore the possibility of using a microcomputer. We started by writing a rough program which was equivalent, at least in processing time, to the final system which we desired. We then used this program as a benchmark to determine whether we could proceed to base our system on a microcomputer. Our initial timing was three to four and a half seconds per student, sufficiently fast to handle most needs of a student body of 12,000 to 13,000.

We then proceeded to implement the system. The technical description of what was done is contained below. I would mention in passing that although the basic object of the system was to provide a method of furnishing to the student an up-to-date statement of progress on demand, we found many other uses for the basic system. For example, checking student athletes for satisfaction of the NCAA academic rules proved a natural for the system and helped us immeasurably in keeping the Athletic Department advised of the status of their various scholarship students. Additional information in pre-enrollment advising was also incorporated as a separate part of the system. Other uses are on the drawing board.

Once the primary principles were adopted implementation of the system began. Several practical guidelines were adopted to help specify the format of the new data within the existing database:

1. The data must be coded in a form that is meaningful to both computer programs and people.
2. The new data must be terse in order to conserve mainframe storage.
3. The new data must have a minimal effect on existing programs that access the database.
4. The data should be able to be "phased into the database" rather than requiring that the entire database be updated at once.

Since the structure of the existing database could not be changed, we decided to use pseudo-courses in the student transcript to hold the new academic data. This solution had several advantages:

1. There were already some pseudo-courses in use (for advisor assignment and fee payment), so the concept was both technically and psychologically acceptable.
2. The transcript was already being disseminated to students and advisors, so no new system for distributing the new data would have to be developed.
3. The pseudo-courses could be implemented compactly, quickly, and with virtually no impact on existing computer programs.

There were two main arguments against the use of pseudo-courses to represent the new academic data:

1. The courses would not be able to represent all of the necessary data.
2. The courses would create clutter on the transcript and cause confusion.

In answer to these arguments it was demonstrated that the necessary data could be codified very tersely, (for example, only the effect of a petition, not its full text need be included) and that only a small number of codes were required. Clutter would occur in some cases, but the majority of students would have at most one or two pseudo-courses on their transcripts. Finally, some confusion was admitted to be a necessary by-product of any type of change in the venerable manual folder system.

The pseudo-course has three components: a department code, a course number, and a course title. (It has no grade or credit hours.) Since most of the folder data is not specific to a department, a new department called "NOTE" was created just to hold the pseudo-courses.

The second component of the NOTE course is the course number. The first character of the field is a letter which is a code for one of the schools in the university. (A = Liberal Arts, B = Business, E = Engineering, etc.) This identifies the origin of the NOTE, since students may be doubly enrolled in two schools or transfer between schools. The rest of the course number is a unique number which gives computer programs enough information to process the NOTE. The number has little intrinsic meaning to a person except that as much as possible it parallels the normal course numbering system.

The course titles in the student transcript are limited to 18 characters, so the NOTE's have to convey their human readable data via extensive abbreviation. The essential information can be captured in that space. However, it has seemed prudent to make available to students and advisors an explanatory sheet which demystifies some of the more creative abbreviations.

Some course titles also carry machine intelligible data. These titles have a specific structure with places to fill in the blanks with specific information. By including this feature, the number of different NOTE's was kept to a minimum.

NOTE's can be classified into three general areas:

1. Exemptions, waivers, and advanced placement

   These are the most common NOTE's, and they arise out of university rules, administrative actions, or petitions.

   An example of a NOTE arising from a university rule would be "NOTE A101 Exmpt Engl 101 ACT." This NOTE exempting the student from English 101 is applied automatically if the student's ACT English score is above 26.

   "NOTE A106 Exmpt Oral Comm HS" results from an administrative action. A student who thinks his High school speech courses will exempt him from the Oral Communications requirement may take his high school transcript to the department for evaluation, and they will issue the NOTE if appropriate.

   "NOTE A111 Exmpt Calculus Pet" is a an example of a NOTE arising from an approved petition. Denied petitions do not create NOTE's.

2. Transfer work evaluation

   A second category of NOTE's deals with evaluation of transfer courses. When transfer work cannot be immediately evaluated because it is the first of its kind from a particular institution, "NOTE A404 Hold Credit Validate" is placed on the transcript until the necessary information is obtained from that institution.

   Other NOTE's exist to allow flexibility in the evaluation of particular transfer courses. These are of a "fill in the blank" variety and allow courses to be evaluated for partial credit, to cancel other courses, and to be equivalent to other courses. An example is "NOTE A408 SPAN 104=2.7H Cncl", which cancels 2.7 hours of the Spanish 104 course. Some of these NOTE's may also be used on resident courses as the result of petitions.

3. Comments

   A NOTE with a blank course number may be entered with a free form comment in the title field. This NOTE will be ignored during computer processing of the transcript. These comment NOTE's are used primarily to flag special conditions that should be brought to the attention of whoever is looking at the transcript. An example of this would be "NOTE Prev Wrk Not Coded" to show that the student has prior course work not in the database.

In the College of Liberal Arts and Sciences petitions and administrative actions are entered into the student record via a microcomputer based "Electronic Folder System (EFS)." EFS is in effect a window into the student's record, both academic and non-academic. The academic data is stored in the mainframe database as has been described. The non-academic information is stored either in electronic files on the microcomputer or in archived paper records. The non-academic information consists of the full text of petitions, summaries of denied petitions, records of grade changes, admissions, and dismissals, and logs of student conferences. EFS stores summaries of this data on disk, and keeps an index to any paper records still kept on the student.

When logged into a student's electronic folder the administrator may obtain a copy of the student transcript directly from the mainframe, run this transcript through the Academic Requirements Tracking System (ARTS), and/or enter petition summaries or administrative actions. If the petition has been approved, or the administrative action generates a transaction (including a NOTE) against the student record, a transaction record is forwarded to the Office of student Records for entry onto the central database. EFS keeps a record of this transaction, and when the student transcript is next down-loaded from the mainframe EFS verifies that the transaction was correctly entered. If the student record is correct then the record of the transaction is deleted from EFS. This assures that information is not duplicated between the central database and EFS. Only data which does not generate NOTE's (like denied petitions) or other changes in the central student record are kept permanently in EFS.

A NOTE appears on the student transcript like a normal course with no further explanation. However, the most common contact a student has with his transcript is during enrollment sessions when it appears as a part of the ARTS form. The ARTS form contains a detailed audit of the student's current standing in relation to degree requirements. Part of this form lists explanatory information regarding special rules or problems with this particular student's record. NOTE's will typically be listed here as well as on the transcript. On the back of the ARTS form a complete listing of NOTE's for the appropriate school is listed. During enrollment each student receives an ARTS form to take to his advisor, so the NOTE's are well documented at this critical time.

Implementing the NOTE department has gone smoothly with a minimum of side effects. As of yet no student has tried to enroll in a NOTE department course.

SUPPORT FOR MANAGEMENT MICROCOMPUTING . . .
ONE STEP BEYOND

Kathy Healy Brey
Roy A. Gruver

Lehigh University
Bethlehem, PA

The rapid acquisition of microcomputers by administrative offices on campus requires a support response somewhat different than that which addressed the proliferation of faculty microcomputers. University managers and others involved in primarily administrative, rather than academic functions, need a more structured microcomputer support mechanism than the traditionally more independent academic and research personnel. Lehigh has responded to this support challenge with the establishment of the Information Center which addresses the special needs of the administrative community. The Information Center provides University administrators with 1) access to centrally located and supported Zenith microcomputer systems, 2) a Home Education Loan Program (HELP) which provides microcomputer systems on long-term loan for at-home learning, and 3) access to portable microcomputer systems for professional travel and off-campus work through the Portable Education Program (PEP). This paper describes the evolution of the Lehigh University Information Center, the current status of its programs, and provides a retrospective analysis of its development.

LEHIGH UNIVERSITY

Lehigh University is a private, coeducational university founded in 1865 in Bethlehem, Pennsylvania. It is dedicated to educating the complete person, while at the same time pursuing aggressively the research which makes a complete education possible. The University has an undergraduate enrollment of 4,400 and a graduate enrollment of 1,900 in four colleges: Arts & Science, Business & Economics, Engineering & Physical Science, and Education. Advanced study and research at Lehigh is conducted in 16 interdisciplinary research centers and eight University institutes, as well as in individual departments. Total research expenditures exceed $21 million.

A full-time staff of nearly 1,100 individuals conducts the business of the University. Lehigh employs 370 faculty, 300 professional, and 400 support staff working in over two million square feet of classroom, laboratory, and office space. The value of the current physical plant is $313 million which will increase significantly with the University's recent acquisition of Bethlehem Steel's Homer Research Laboratories. Generous supporters and benefactors of the University continue their contributions to an endowment of $158 million. This year's operating budget is $108 million which supports one of the University's most ambitious undertakings on its history: the Lehigh University Network.

NETWORKING at LEHIGH . . .

InteCom IBX/80

After a year of preparatory study and review, and another year's intensive search, Lehigh contracted with InteCom of Dallas for a campus-wide voice/data communications network. It is the most complicated construction project in the University's history. This network of nearly enough twisted-pair wire and fiber optic cable to encircle the globe links 126 campus buildings, including classrooms, offices, laboratories, and living areas. These links position Lehigh on the threshold of a new era in education.

The Lehigh Network has the highest ratio of data to voice ports at any campus in the country. Sixty percent of the Lehigh Network communications lines are dedicated to data. It is a highly data-intensive system designed to support the revolution in how education takes place, as well as in how the enterprise of education is managed. The Network brings all the resources of the University into each individual office, classroom, laboratory, and living area.

Mainframes & Micros

Simultaneous voice and data lines for all members of the Lehigh community link individuals to each other, to over 15 campus mainframes and mini-computers, and to the vast array of data resources outside the University. An integral part of the implementation of the Lehigh Network was a plan for distribution of microcomputers to all Lehigh faculty and installation of micro systems at University public sites. With the cooperation of Zenith Data Systems, Lehigh has provided, at no cost to departments, microcomputer "windows" to the Lehigh University Network for each faculty member. In addition, approximately 200 Zenith micros have been installed in public sites, such as the libraries, and micro labs across the campus.

Since microcomputer systems without software are of little functional value, the University has provided with each microcomputer system a "software survival kit". This kit consists of the site-licensed packages Freestyle and InteCalc for word processing and spreadsheet respectively, and several public domain packages for data base, graphics, and communications. Provision of this kit makes the microcomputer immediately usable. Nevertheless, while the "free" software is adequate for most faculty and student needs, it does not meet the needs of most administrative office environments. Other software which does is supported by the Information Center and is discussed below.

Network Services

These microcomputers, mainframes, and communication links are themselves very important tools for Lehigh. However, the point at which they all come together is Network Services. It is here that the machine-to-machine data capabilities of the digital PBX and the people-to-people information and communication facilities are based. Lehigh and IBM are involved in a two-year joint study project to develop a "network services" prototype for colleges and universities. This Lehigh/IBM project implements its information communication services under the MUSIC (McGill University System for Interactive Computing) operating system. Lehigh is working with the MUSIC team to develop and document requirements for product consideration.

Lehigh's network server is an IBM 4381, model 13. It supports electronic mail, calendaring and scheduling, file and text services, printing services, communications to the library on-line catalog, other University computers and access to external networks. Potential future services could include on-line class and exam schedules, bulletin boards, a software library, and access to departmental accounting information. User support is a major part of "network services", and an online, context-sensitive HELP facility is provided in order to help members of the Lehigh community use this sophisticated tool most effectively. A consistent user interface with the same menus and screen formats helps reduce confusion. Currently, the network is operating with a volunteer group of faculty, staff, and students, but network services will be made available to the entire campus community during the Spring of 1987.

COMPUTING at LEHIGH . . .

Lehigh, as most institutions, relies greatly upon computing resources for instructional, research, and administrative processes. Symbolic of the new era of computing at Lehigh was the dedication in Spring 1985 of the new E. W. Fairchild-Martindale Library and Computing Center. This facility houses the Computing Center and Administrative Systems offices, a large user's area, microcomputer lab and the central site's four mainframes: a Control Data Corporation Cyber 180/850, a Digital Equipment Corporation DECsystem 2065, an IBM 4381 model 13, and an IBM 4381 model 11, the latter used exclusively for administrative processing.

Administrative Computing

Support of administrative computing at Lehigh is the task of the Administrative Systems Office. The Office is composed of three sections: (1) Systems and Programming, (2) Information Center, and (3) Data Management Office. Systems and programming provides new systems design, systems analysis, and programming services.

The Information Center is responsible for microcomputer support and is described in detail below. The Data Management Office is responsible for managing the online and batch production data and applications, scheduling and running production jobs for the users, and providing batch data entry support. Total staff of the Systems Office is 23.

Administrative Applications

None of the administrative applications are over 5 years old, and each application is available real-time, online. Although there is a mix of purchased and in-house developed applications, major applications were purchased from Information Associates, Rochester, NY. They include: Financial - accounting, accounts payable, purchasing; Human Resources; Student Systems - student records, financial aid, student billing & receivables; and Alumni/Development.

The implementation of micro-mainframe data sharing (download/upload) for all applications has been a major recent endeavor. Prior to this project, there were no specific, published University guidelines for information responsibility and security. There certainly was a need for such policies before, but now there is an even greater need.

There is a formidable amount of physical security in the administrative network. Dedicated terminals and printers in locked offices, no microcomputer connections, no software for downloading, password protection (for communications lines, applications, and data elements), and secured distribution of output all support control of access to information and printed reports. However, making data available for microcomputer use permits easy changing of information and further electronic distribution to unauthorized users. How is distributed information protected? Given people's almost unquestioning acceptance of computer printed output as a legitimate information source, how is database authenticity maintained? How can information that is uncontrolled be safeguarded? The Micro-Mainframe Data Sharing Policies & Procedures Manual (available upon request) addresses these questions and identifies information as a University asset, explains the purpose of data security, lists responsibilities, and details procedures.

Support

The computing support which Lehigh delivers as an institution varies, of course, with the needs of different user groups. The form in which we provide that support depends upon the nature of the differences between these groups. At Lehigh, there have been two major user groups: academic/research and administrative. Academic and research support services are concentrated in the Computing Center's User Services office and administrative support services are provided by the Administrative Systems Office. The form in which support is provided depends upon 1) the user's level of computing independence, and 2) where they go for support.

The academic and research communities are much more independent in their use of computing. They run their own jobs. They pick up their own output. They backup their databases. Quite often, they develop and modify their own programs. Administrative users, by comparison, can be characterized as dependent - a characteristic encouraged by the traditional administrative computing structure. They are provided ongoing application program support, production support, backup/recovery, and disaster planning. Although they are intimately involved in their applications, this involvement is usually limited to the functional aspects. They rely upon the Administrative Systems Office to take care of the technical details.

The locus of support is also different for academic and administrative users. The academic and research communities have a central site orientation. Their computing power, their help desk and hot line, consulting support, and training are all at the central site. They are accustomed to bringing their problems "in" to the Computing Center. Administrative users, on the other hand, are accustomed to having support delivered.

Microcomputing Changes

In planning for microcomputer support, these user differences must be taken into account. For the academic users, microcomputing provides "central site" computing power to individuals who are already accustomed to using that power themselves. For administrative users, microcomputing adds new demands and responsibilities: development, testing, trouble-shooting, backup, security, and information management. These are responsibilities they are not used to dealing with. Support services have to be available to help administrative users cope with their new responsibilities. Our goal is to help users develop these newly required skills, rather than assume the responsibility for them.

The critical support service differences correspond to key differences in the user groups. In the area of **Data Ownership**, academic users usually have individual custodial responsibility. Administrative users, on the other hand, require interdepartmental data sharing with central custodial responsibility. The **Software Choices** of academic users are dictated by individual preferences, while the choices of administrative users are dictated by University and departmental needs and goals. **Problem-solving** among academic users is normally internally generated and geared to discovery support. The process is often more important than the result. Problem-solving among administrative users, however, is externally forced and geared toward decision-support. The process is rarely as important as the result. Academic computing has always been end-user computing. **Computing Responsibilities** have resided traditionally with the user. The tradition in administrative computing has been to rest computing responsibility with Data Processing. Requirements for **Direction and Control** are significantly different in these two user populations. Academic computing is guided by the principle of academic freedom. Non-standard hours are the norm and flexible timetables are common. Administrative computing is subject to extensive internal and external regulation. Standard hours and rigid timetables are the norm.

Because of these significant differences, support mechanisms to meet administrative needs must include:

- Policies and procedures to clarify data ownership and accessibility.
- Standards to guide software selection and use.
- Immediate help (hot line, consultants) and problem-solving.
- Policies to control security, backup, maintenance, and information release.

THE INFORMATION CENTER . . .

The Information Center meets the special needs of the University administration through centrally located equipment and services, on-site and phone help, and education programs. Information Center equipment consists of Zenith microcomputer systems, several donated by Zenith Data Systems. The Walk-In Center is equipped with one AT-compatible ZW-241 and two XT-compatible ZW-158's. The 241 is used by the Information Center manager for development of educational materials, sample applications, communications, and program management functions. The 158's are available at all times to University administrative personnel - professional and support staff - for word processing, spreadsheet, data base, network communications, or other applications.

In addition to the Walk-In Center machines, five additional micros support the Information Center's education programs. Two XT-compatible 158's are dedicated to the Home Education Loan Program, and three ZFL-171 Portable micros are used for the Portable Education Program. Most of this Information Center equipment is maintained in a secure, alarm-equipped office environment. However, the Portable Education Program, by its very nature, demands additional protection. After investigating numerous alternatives, the Information Center obtained a microcomputer insurance policy covering its equipment and media against loss or damage. Most policy restrictions are acceptable and the portables are covered in most situations.

Center Services

An important part of Center services is the walk-in use of microcomputer systems and software. In contrast to the University faculty, administrative offices were not provided with microcomputer systems. These offices are required to purchase micros with their own funds, which means inevitably the sacrifice of other resources. For those offices as yet unable to purchase a micro, the Walk-In center is particularly valuable. In addition, offices which do have microcomputer systems may have occasional need for software which they cannot afford to buy. The Walk-In Center serves this need as well.

Information Center staff members assist administrative users in the development of microcomputer applications using Center supported software. While the Information Center cannot mandate the purchase of specific software for administrative use, it encourages the purchase of certain software which fulfills administrative requirements by providing strong support for that software. Center supported software includes IBM Fixed Disk Organizer, MultiMate Advantage, LOTUS 123, and dBASE III Plus. These comprehensive software packages cover the largest range of administrative applications and meet Center criteria for administrative software: ease-of-use, maturity and support, and transportability. Center supported software packages are among the top ten corporate best-sellers and rated well by independent software evaluators.

Information Center staff provide a wide range of application development assistance for administrative areas, from project consultation to project management, or complete system development. Examples of this assistance provided to-date include: project consultation to the Office of Financial Aid in the development of a dBASE III Plus Work-Study Job Management System, preliminary project consultation to the Office of Career Planning & Placement for the development of a dBASE III Plus

Recruiting Information System, and ongoing project management and system development assistance to the Graduate Office for the development of a dBASE III Plus Graduate Admissions Information System.

As part of its charge to assist administrative offices in the transition to and incorporation of microcomputers in the conduct of University business, the Information Center provides data and conversion services. A substantial part of this service component is directed toward offices currently equipped with IBM Displaywriter systems. In order to encourage and assist these offices in converting to micros and the tremendously increased flexibility they provide, the Center provides complete Displaywriter file conversion including: TextPack to DCA or ASCII, and ReportPack to ASCII - at a nominal fee per diskette converted.

Micro-mainframe data sharing, as described under Administrative Applications above, has been implemented through the testing and purchase of software, and the formulation of policies and procedures to guide this process. The transfer of data processing responsibilities that accompanies the transfer of mainframe data must be guided and supported in a way which imposes as few restrictions as possible, while at the same time ensuring mainframe-quality data security and integrity.

The Information Center has also begun the implementation of an administrative test-site for the use of automated tape backup. After extensive evaluation and testing of tape backup systems, the Center has settled on a system which meets the crucial criteria for administrative use: ease of use, transportability, and equipment compatibility. The supported system has been functioning flawlessly in the Information Center for approximately two months and will be installed in test-mode in the Office of the Controller shortly.

On-Site & Phone Help

Information Center staff members spend a significant proportion of their time providing on-site and phone help. The Information Center makes equipment and software recommendations, assists the user office in installation of purchased equipment and software, and provides follow-up assistance, for example, upgrades.

Troubleshooting user's difficulties, either on the phone, or on-site in the user's office is a daily responsibility. If the problem cannot be resolved on the phone in a reasonable amount of time (approximately one half hour), then an Information Center staff member goes, as soon as possible, to the office requesting assistance. Information Center staff perform software and hardware troubleshooting and preliminary equipment diagnostics. This on-site assistance is particularly important for administrative offices which are up against deadlines constantly in conducting analyses or producing reports.

Many of these offices have been accustomed to fast, on-site response from vendors such as IBM. Since administrative offices are obligated to pay for their own microcomputers and have sacrificed, consequently, some other resource to get these machines, they want as much productivity as possible, as soon as possible. In addition, it is the University's goal to encourage the productive use of microcomputers and the new communications network. Therefore, every effort is made to assist offices with this transition, and everything possible is done to resolve problems quickly.

Education Programs

The Information Center conducts education programs for administrative users in a number of areas. Informal education is conducted on a daily basis during every contact with users. Each encounter is treated as an opportunity to inform and foster independence. Formal education programs include an Introduction to Computers, Microcomputing for Managers, the Home Education Loan Program (HELP), and the Portable Education Program (PEP).

Introduction to Computers is a two hour, lecture/discussion session conducted in an informal, non-threatening setting, away from computers. This introduction is designed to encourage positive attitudes towards computers by providing basic introductory information. The three major goals of this workshop are: 1) to make participants aware of the resources and help available to them, 2) to convince participants that computers are not so mysterious, and 3) to encourage participants to begin integrating micros into their life at work.

Microcomputing for Managers, on the other hand, demonstrates the importance and use of microcomputers in a managers work. The half day workshop begins with a discussion of the obstacles and incentives to management use of micros. Resources which support management use of microcomputing are then described. Of particular importance to managers is a discussion of policy issues relevant to microcomputing. Data integrity, security and legal obligations are areas for which managers are directly responsible. Therefore, management responsibilities are made explicit and discussed. A hands-on session in dBASE III Plus follows the discussion section of the workshop. Participants are provided with a "live" data set downloaded from a mainframe application system, and guided through a typical management exploration of that data.

The Home Education Loan Program is designed to provide University professional staff with the opportunity to explore the uses of microcomputing in a non-threatening environment, free from time and staff pressures - in their homes. The unstructured, error-tolerant environment in a manager's home encourages longer periods of uninterrupted micro use and a more concentrated and efficient learning effort. This results in a higher learning payback than brief encounters in a busy, high-visibility office setting. Newly acquired skills can be applied quickly to professional tasks and translated easily into a requirement for microcomputing in the office. Information Center staff provide intensive start-up assistance to participants in the Home Loan Education Program. After-hours phone and, if necessary, on-site help is provided. The education and subsequent support of managers are critical to the achievement of the University's goals in incorporating microcomputing and networking into the fabric of Lehigh administration.

The Portable Education Program ensures that developing microcomputer and network skills can continue to be used away from the campus at seminars, conferences, or other professional meetings. These portables are provided to managers with a standard software pack which includes MS-DOS, network communications, and word processing. Additional software can be made available, or managers can supply their own. The Information Center also loans these portables for short-term home use, if they are not already committed for professional travel.

Future Directions & Goals

Based upon the experiences of this past year, the University has established a number of goals for the Information Center. Additional staff and an improved Walk-In Center environment are priorities. At the present time the Center staff consists of one full-time manager and one half-time consultant. The goal for the coming year is to increase the half-time consultant's position to full-time. In addition, the physical environment of the Walk-In Center will be improved with some additional acoustic partitions, library shelf space, and work space.

A top priority for the coming year is the acquisition of a laser printer for the Information Center. The University has standardized on the Hewlett-Packard laserjet line and administrative offices are quickly acquiring these sophisticated printing devices. The Information Center must be able to provide full support for this product and the software which drives it, but cannot do so without its own device for regular use and testing.

One of the ever-present problems for administrative offices is lack of funds. While many University offices have been able to reallocate resources, or through some other creative means find the dollars to purchase microcomputers for their use, they continue to come up short of funds for the purchase of appropriate administrative software. The Information Center is working to persuade the University to establish a Software Fund similar to research or equipment funds available to the academic community. Administrative offices could then apply for monies from this fund to finance the purchase of required microcomputer software.

In spite of the fact that the issues of data integrity and security are addressed in the Information Center's education programs, a more systematic and thorough program of security awareness must be implemented during the next year. Lehigh is a member of the Information Systems Security Association and Information Center management takes an active role in developing, using, and disseminating security information and programs. Administrative Systems is working currently with the Internal Audit office at Lehigh to design a security awareness program for University employees.

Local Area Networks must also be addressed in the coming year. The University has tested a number of network products, but not yet standardized on network hardware or software. Many administrative offices requested that the Information Center explore the feasibility of LANS in their environment. And there are many office environments where a LAN would in fact be appropriate. Therefore, the Information Center will actively investigate and test this technology for administrative offices.

Finally, and perhaps most importantly, promoting effective use of the Lehigh Network is a goal to which all others ultimately contribute. The University has invested an unprecedented amount of resources in the purchase and installation of this campus-wide communications network. If the full potential of this significant investment is to be realized, then substantial Information Center efforts must be directed at educating as many administrative personnel as possible in effective network use.

IN RETROSPECT . . .

The Information Center has been in existence just slightly over one year. We believe it has provided a high level of service to a significant population. Several factors have played a major part in helping us offer needed services. Certain directions were consciously chosen, certain things just happened. Not everything that we tried turned out positively. We learned a lot along the way.

Concentrate efforts on achievable objectives.

Our initial plan for the Information Center was to provide general administrative consulting (mainframe & microcomputer). As it happened, the demand for microcomputing consulting quickly consumed all the time of our entire staff (of one). And that was okay. At least we were providing a desperately needed service. The other objectives could wait temporarily. At several other points in time, we again evaluated our position. It remained unchanged. We decided to concentrate and expand microcomputer support at the expense of other previously desired services.

Attempt to extend limited resources with Partnerships.

When the Information Center staff position was created, we were provided with enough funds for a workstation, a microcomputer, and initial training. There was no operational budget or money for software. We had to make it on our own. We decided to look for partners with resources.

ZENITH DATA SYSTEMS - For us, Zenith proved to be a major milestone, not only because they donated equipment, but because it was our first proposal for support. Lehigh had an agreement with Zenith to sell microcomputers to the University at favorable prices. We approached them for hardware and software to assist in developing microcomputer literacy in the administrative arm of the University. We didn't get what we asked for. But, we did get enough to start the Home Education Loan Program and the Portable Education Program. You only get one chance, so ask for what you need and can support.

LEHIGH UNIVERSITY MICROCOMPUTER STORE - Next we approached our campus micro store for help. The store would obviously benefit from any sales we could help generate with our literacy programs. We got a positive response, but the current financial position of the Store precluded any extensive help. The Store was able to give us two printers recently received as a sales bonus from the printer vendor. The Store also provided memory upgrades, carrying cases and modems for the portable machines. Look inside your institution for donation of resources.

OTHER VENDORS - In desperate need of a laser printer, we contacted a full-service (sales, maintenance, software support, consulting) printer vendor. Since they could provide services which we could not, we offered to showcase their printers in our walk-in center, believing that this cooperative effort could benefit us both. Unfortunately, our institution's purchasing office had an agreement (non-contractual) with another vendor to supply the same products. The chosen vendor would not provide the same level of support, but did offer a lower price. We were not able to do business. Know your institution's purchasing policies. When existing policies don't help you meet your business objectives, work to change the policies.

DEVELOPMENT & ALUMNI OFFICE - Present a proposal to your development office. They may have unrestricted funds or be able to help you raise money specifically for your needs. Ask Alumni to earmark contributions for your office. Be inventive, try new ways.

Try to replace competition with cooperation. Be willing to try and keep trying.

At Lehigh we have at least two other organizations which provide microcomputing support: the Computing Center and the Microcomputer Store. We try to prevent service overlap with the other groups by limiting our software support, workshop programs, software and hardware evaluations. We meet regularly with both groups to review recent problems and new products, and to find out what each is doing. Don't tolerate infighting, petty jealousy, or other destructive forces which could disrupt achievement of your goals. Go to the highest levels necessary to deal with this.

Win upper-level management support. It makes things happen.

Our upper management has been extremely supportive. Develop a written plan specifying your goals. Convince management that by helping you meet your goals they will help ensure the institution will meet its. Demonstrate progress toward meeting your goals.

Win user support. Without users, what good are we?

Nothing helps more than satisfied users. When introducing new services, start out on a small scale working with one or two offices initially. Not only does it limit the extent of potential disasters, but it gives the users a stake in the outcome, a feeling that they are important and are getting attention, and enables the technical staff to develop a much closer relationship with user office staff than might normally be possible. In succeeding projects, work with a different set of initial users.

Find new ways to pay the bills. Look for non-traditional financing sources.

Try to determine how much the institution is paying for outside microcomputing consulting services. We found tens of thousands of dollars were being spent for onetime system development. We were able to get additional staff in spite of an extremely tight budget, based upon our ability to provide continuing services at far less cost. Charge for some services. You may be able to partially finance new services. Our data conversion service is paying for tape backup boards which we will provide to user offices.

Find dedicated, capable people and try to keep them.

This is not such a novel approach to success. We have not only excellent, extremely capable Information Center staff, but a very cooperative, very professional Systems staff in general, helping to support the Information Center.

MICROS AND FACULTY: A DEVELOPMENTAL APPROACH TO INSTRUCTIONAL ENHANCEMENT

Morell D. Boone
Dean, Learning Resources
and Technologies

Robert L. Ferrett
Director, Center for
Instructional Computing

Eastern Michigan University
Ypsilanti, MI 48197

ABSTRACT

In 1984, Eastern Michigan University created the Center for Instructional Computing (CIC) to inform its faculty about the use of the microcomputer and its potential for instructional enhancement. In January, 1986, the CIC became the central component in an administrative reorientation toward an emphasis on faculty involvement in the development and use of learning technologies.

This paper will: 1) Introduce the topic; 2) Review the background supporting such an approach; 3) Present the institutional setting; 4) Discuss the formation of the Learning Resources and Technologies administrative structure; 5) Describe the CIC's program; 6) Demonstrate the CIC's impact; and 7) Draw a set of conclusions about this approach.

Introduction

Along with many other educational institutions, Eastern Michigan University is trying to address the question, If computer technology is an important part of instruction and learning, how do we plan for its development and use?

This paper deals with this question and Eastern's attempt to answer it. An opportunity for faculty development in the use of microcomputers within a reoriented administrative structure emphasizing the development, use and support of learning technologies will be discussed.

Background

The emergence of the microcomputer as a serious tool for information processing is causing significant changes on many college campuses. Even though mainframe computing has been available for faculty use in teaching and research, its impact has not been felt in most instructional settings. However, the potential impact of the microcomputer has institutions rethinking the role of computing in instruction and learning.

In the recently released "Carnegie Recommendations on Undergraduate Education," it is suggested, ".....computer hardware should not be purchased before a comprehensive plan has been developed, one that covers personal computers, information services, and the use of technology by the institution."[1] This seems to be a wise suggestion, especially in light of the debate on defining "computer literacy" combined with the unresolved issue of hardware compatibility. However, the problem for many institutions is either the "revolution" has already begun without such planning, or the resources, both human and fiscal, are insufficient to provide for appropriate planning.

According to the 1984-85 Higher Education Utilization Study (HEUS), planning is taking place in about two-thirds of all institutions surveyed. Specifically, either a task force has been appointed, or an individual administrator designated to look into the use of audio, video, and computers for instructional purposes.[2] Even with some evidence of thinking or, in some cases, planning about computers in instruction, the fact still remains that, unlike administrative computing, instructional computing depends on a group of intermediaries (faculty) between the technology and the end benefactor (students).

Managers of campus computing traditionally have been expected to work with a well defined need for computer applications, but the new task of integrating computers with instructional methods is a different challenge.[3] Consequently, planning and implementation for instructional computing has not happened at the same rapid pace as it has for administrative computing.

---

[1] "Text of Carnegie Recommendations on Undergraduate Education," **The Chronicle of Higher Education**. November 5, 1986, p. 21.

[2] Steven W. Gilbert and Kenneth C. Green, "New Computing," **Change**. May/June, 1986, p. 34.

[3] Judith A. Turner, "Role of the Computing Director Is Increasingly Managerial," **The Chronicle of Higher Education**. September 17, 1986, p. 18.

Keeping the various factors of present reality in mind, the question is, What can, or should we do about bringing microcomputers into instruction? We do have data from a dozen or so pioneering, technologically sophisticated institutions, such as Brown and Carnegie Mellon. These universities have attempted to promote campus use of new technologies in several stages of implementation to:

1) Provide initial access to the technology for students and faculty.
2) Provide training for faculty.
3) Provide general software.
4) Provide instructional software to meet individual needs.
5) Provide related support services.[4]

However, many of their experiences are labeled "unique" and seldom seem to offer much help for "my" particular campus. Computer implementation issues have not become more clearly defined. On the contrary, they have become more complicated and harder to resolve. With problems becoming more complex, pressure mounts on each campus to either lean toward Harvard's Derek Bok's statement, the "experience should make us wary of dramatic claims for the impact of a new technology,"[5] or move toward Houston's Richard Van Horn's position, that "The computer is, then, an exceptional learning tool. But it is exceptional, not because of the technology by itself, but because of the fit between technology and the basic elements of the learning model."[6]

If the computer technology is a good fit in the learning process, up to now it has not promoted a fundamental change in higher education -- Why? For computer technology to show an improvement in teaching and learning, two things must happen. First, faculty must be assisted in learning how to use microcomputers in terms of their own teaching methods. Second, organizational traditions must be reoriented to accommodate the motivation of faculty to integrate microcomputer applications into their own instruction.[7] With these two conditions addressed, an institution should be able to begin to introduce an opportunity for instructional enhancement that will lead to a fundamental change in teaching and learning effectiveness.

Institutional Setting

Eastern Michigan University (EMU), located in southeastern Michigan, is a comprehensive University with a current enrollment of 23,000 students (17,000 undergraduates) and a full-time faculty of 650. In September, 1986, a survey about faculty use of microcomputers was conducted with the assistance of the University of Michigan's National Center for Research to Improve Postsecondary Teaching and Learning (NCRIPTAL). The results showed that 45 EMU faculty are presently using microcomputer applications in their instruction. However, almost an equal number (40) requested immediate assistance in learning how to use such applications in their instruction. These results are not surprising, since EMU has yet to develop a comprehensive microcomputing plan, but has adopted a strategy to develop faculty awareness of computing applications in instruction and a reorientation of the Academic Affairs Division's organizational approach to microcomputer applications in instruction.

---

[4] Gilbert, p. 35.

[5] Gilbert, p. 35.

[6] Richard L. Van Horn, "Brave New Worlds: Computers Revolutionize Learning," **Educational Record.** Winter, 1986, p. 17.

[7] Gregory A. Jackson, "Technology and Pedagogy," **Change**. May/June, 1986, p. 57.

In 1983, Provost Ronald W. Collins took deliberate action in response to the establishment of the first general-purpose microcomputing laboratory for students. He asked Dr. James Spain, a Professor at the Michigan Technological University, to come to EMU as a Visiting Professor of Chemistry for the 1984-85 academic year. Dr. Spain's assignment was to launch a faculty development effort, to be known as the Center for Instructional Computing (CIC). Working directly with Provost Collins, Dr. Spain introduced approximately 30 faculty members, mostly in the sciences and education, to an Apple environment and assisted them in using existing software and in developing their own software applications. In addition to working directly with these 30 faculty, he also held campus-wide workshops to begin to raise interest for microcomputers in instruction. These activities set the stage for an expanded role for the CIC during the 1985-86 academic year. An EMU College of Technology Lecturer, Robert Ferrett, became the CIC's second Director. Changes were made in the approach and the reporting line. The approach was changed to concentrate on an MS-DOS (IBM) environment with the Apples being loaned to faculty needing them. Also, the direct administrative reporting relationship was changed from Provost Collins to Dr. Morell D. Boone, the Director of the Center of Educational Resources. What follows is a description of what has happened in regard to the organizational reorientation and the assistance given to faculty in using microcomputers.

Learning Resources and Technologies (LR&T)

In January, 1986, a reorientation of the administration of resources and technologies for instruction and learning was implemented. A Dean's position was created to oversee the development of linkages of information and educational technologies to the library, media and instructional support services (including the student microcomputing lab), and the classroom. Dr. Morell D. Boone was promoted from his previous position as Director of the Center of Educational Resources to the Dean of Learning Resources and Technologies. In addition to the administrative responsibilities of such an activity, Dr. Boone also established a Learning Technologies Development Unit. The first component to be implemented and physically incorporated into the revised organizational structure was the Center for Instructional Computing (CIC). The other two components to be implemented in the near future are: The Center for Educational Television (CET) and the Center for Information Technology (CIT). The goal for all three centers is basically the same. It is to stimulate research, development and use of new learning technologies in serving as a central coordinating unit for the integration of each technology into the instruction offered by the faculty.

It is not by chance that each of these development centers has a companion service unit within the LR&T. That is, the CIC has the Student Micro Lab, the CET has Media Services, and the CIT has the Library. In addition, the CIC has an affiliation with University Computing, which is administratively outside of the Academic Affairs Division. The Dean is the liaison between CIC activities and the Executive Director for University Computing, whose responsibility it is to provide all types of computing systems for both administrative and academic services.

The Center for Instructional Computing (CIC) Program

The CIC is physically located in the University Library building. The facility houses a five-station IBM-PC Microcomputing Lab, Director's office and conference room with print and software collections. During the current academic year, the five IBM's will be upgraded to hard-disk, two Apple MacIntoshes, a laser printer, and software will be added. The program is organized and delivered by its Director, Robert Ferrett.

The program of the CIC goes far beyond the physical boundaries of the Lab. Some of the major components of the program are:

- Workshops in the Lab
  Five faculty members per hands-on session, such as: Introduction to Microcomputers, dBase III, ENABLE, MAPPING, BASIC, CAI Authoring Systems.
- Lab Use and Assistance
  Faculty are encouraged to use the Lab, with or without professional assistance, in developing their own software applications.
- Equipment Loan Program
  Five Apple IIe's are available for loan to faculty members who are working on projects requiring this type of hardware.
- Instructional Computing Annual Grants Program
  Each year a minimum of eight faculty are awarded stipends to develop software applications that will be used directly in the classroom instructional process. Each recipient is expected to complete a final report on the project and also present an oral report of the activities and results to an instructional computing symposium.
- Newsletter
  A monthly newsletter is distributed to all faculty. It contains a schedule of workshops, software reviews, print reviews, conference announcements, and other pertinent information about CIC programs and micros in instruction.
- Tipsheets
  These are on-demand information sheets about any micro-related issue, such as: Tipsheet #1 - BASIC random files to dBASE files.

- Advisory Board and Departmental Liaisons
  Faculty members from across the campus are invited to serve on the Board that advises the Director and the Dean on policy matters. In addition, each department in the five colleges has a faculty member serving as a "development liaison." The CIC Director uses these individuals as departmental contacts.

- Symposia
  Once or twice a year, a national-level expert in instructional computing and/or instructional development is invited to hold a session or sessions with faculty on a topic of interest.

- Research and Development Grant-Seeking Assistance
  The Director offers assistance to any faculty member wishing to identify funding opportunities and/or write a proposal in the area of instructional microcomputing.

The CIC's impact

For a total annual expenditure of under $60,000, the CIC provides assistance to faculty on a voluntary basis that is difficult to measure in empirical terms. However, both formative and summative evaluations are being planned. In the interim, the best measure for the impact and success of the CIC program is seen in its encouraging use statistics and positive reactions from the faculty who feel that many of the psychological barriers to the effective use of microcomputers have been removed.

There are two major indicators of impact that can be identified. First, there is the quantitative indicator of numbers of faculty using the lab for workshops and for development activities. Second, there is the qualitative indicator of faculty who have won competitive grants for the development of innovative instructional computing applications.

Under the first indicator, numbers of faculty using the lab during a fourteen-week period in the Winter, 1986 Semester, 117 different faculty participated in hands-on workshops and/or used the lab during open periods. During a seven-week period in the Spring, 1986 Session, 26 first-time faculty users were accommodated, and during the first fourteen weeks of the current semester (Fall, 1986), an additional 55 first-time faculty users participated in lab activities. Overall, since the lab opened on January 16, 1986, until December 1, 1986, a total of 198 different faculty members, from a wide variety of disciplines, have come to the lab. These faculty have made a total of 770 contacts and used the lab for a grand total of 2,532 hours.

Under the second indicator, grant recipients, the 1985-86 program saw nineteen qualified applicants for eight awards ($1,200 each) given. The projects are:

- Laboratory Disorders of Coagulation (Associated Health Professions) -- Creation of computer-assisted instruction programs to train clinical laboratory scientists.

- Introduction to Interior Design Lab (Human, Environmental and Consumer Resources) -- Development of a new computer course in Interior Design.
- Microcomputer Practice Problems for Cost Accounting (Accounting and Finance) -- Creation of a self-study statistics computer manual in cost accounting.
- Development of an Interactive Cost-Volume-Profit and Standard Costing Microcomputer Instructional System (Accounting and Finance) -- Creation of software modules in cost accounting.
- Development of RANDMAP Applications (Geography and Geology) -- Adaptation of RANDMAP software package for use by students in learning mapping techniques.
- An Update of Computer-Augmented Logistics Instruction (Marketing and Business Law) -- Modification and updating of computer-based simulation program in business logistics.
- Computer-Based Training and Interactive Video (Interdisciplinary Technology) -- Study of interactive video applications in instruction.
- An Introductory Tutorial for Learning SPSS-X (Sociology) -- Creation of a tutorial program to train computer users in using SPSS-X on a VAX editing facility.

Each award recipient has completed the project described above, filed a report and, in November, 1986, made an oral presentation at the annual Grants' Symposium. This two-year-old program has provided a total of sixteen faculty the opportunity to enhance their instruction by developing appropriate computer applications.

Conclusions

If an institution has both sufficient human and fiscal resources to engage in effective learning technology planning and implementation, then it should do so. However, if either or both are lacking, in order to bring technology into a fit with the basic elements of the learning model and to assist faculty in learning how to use microcomputers within a reoriented structure, a different approach should be used as a prelude and a companion to planning.

Eastern Michigan's Center for Instructional Computing, within the newly reoriented Learning Resources and Technologies administrative structure, is an example of a developmental approach to the use of microcomputers in instructional enhancement. It is Eastern's first step in bringing about a future which will eventually recognize the appropriate place for multi-levels of computing support in the instructional and learning mission of the University. Within the human and fiscal constraints of the current environment, it is felt that an informed and knowledgeable faculty will be the most successful catalyst for desired change.

The next step in this developmental approach is to motivate and assist an increasing number of faculty to integrate computing within their own instructional methods. They, in turn, should be able to assist the University in developing an appropriate planning response to a set of clearly defined needs.

Track VII

Managing Academic Computing

Human society has been and will continue to be dramatically affected by technology. Colleges and universities in particular have a responsibility to examine the role of technology in carrying out their educational mission. Properly managed, academic computing provides tomorrow's leaders the knowledge and the tools to use information technology to the benefit of mankind. Papers in this track examine how best to manage the academic computing environment with its diverse constituency of faculty, students, and researchers.

Coordinator:
Philip G. Charest
Villanova University

Trudy Bers
Oakton Community College

Joe Miller
Villanova University

Mary Miller
Virginia Tech

ACADEMIC COMPUTING, SHOULD STUDENTS BE REQUIRED TO PURCHASE PERSONAL COMPUTERS?

Joseph C. Miller

Villanova University
Villanova Pennsylvania

The Engineering College at Villanova University is wrestling with the question: Should Villanova incoming freshmen engineering students be required to purchase their own personal computer?

Other institutions are addressing, or have addressed a policy or posture to answer similar questions regarding their institition. Discussions with some of these institutions are proving of worth to Villanova and should prove of value to others.

This paper will deal with additional areas which we feel are necessary to consider when adopting a policy which requires students to purchase a personal computer:

- The effect on students (commuting vs dorm, ability to pay for the cost and upkeep of their PC).
- The impact on university facilities (dorm room area, telecommunications, printers, peripherals).
- The effect on other colleges, divisions, disciplines, at the respective institution.

ACADEMIC COMPUTING - SHOULD STUDENTS PURCHASE PERSONAL COMPUTERS?

Introduction

Villanova University is a private coeducational institution founded in 1842 by the Order of St. Augustine. The University, comprised of 5 undergraduate colleges, the Graduate School and the School of Law, enrolls approximately 12,000 students, just over half of which are full time undergraduate. Almost every state in the nation and 30 foreign countries are represented in Villanova's enrollment, and the academic philosophy is permeated by a commitment to provide each of its students with a well rounded education.

Formal computing at Villanova University began in the early 1960s with an IBM mainframe computer. Subsequent improvements were made to increase computing power leading to our present configuration of an IBM 4381 group II and one each of VAX 11/785, VAX 11/780, Vax 11/730 and a Vax 8200 networked to 3 campus clusters and the computer center.

Trends in Academic Computing

Background:

1960s " Mainframe Computers" - huge, powerful, expensive.

Since the '60s academic computing capabilities have been supplied by a central mainframe computer, initially limited by access to peripherals available on campus. Many mainframes have been and continue to be used for both administrative and academic purposes, causing concerns about equal time, accessability, and overload at critical times.

1970s "Mini" computers - smaller, less powerful, less expensive.

With the advent of the mini and supermini computers many institutions have dedicated these computers to student usage, accessed by terminals available in clusters in various locations throughout the campuses. Minis have helped to alleviate the burden on the mainframe and put more access into the hands of the students.

1980s "Micro/PC" computers - small, less powerful, much less expensive.

With the PC a student could, for the first time, have a personal tool dedicated to the individual. Again, PCs would lessen the load on the mainframe/mini (for a brief period of time). With the reduction in costs, should every student be required to own their own personal computer?

Mid 80s "Networking" - Expensive rewiring of campus.

Many institutions are already in the process of providing network capabilities for their students, others are in various stages of studying networking at their institutions. Problems being addressed are: PC to mainframe, PC to PC, PC to mini, mini to mainframe connectability; telecommunications, and distributed processing. Networking will increase the load on the mainframe/mini.

In the fall of 1984 the National Task Force on Educational Technology was established by the Secretary of Education. The report was to focus on the usefullness of technology for learning, emphasizing electronic information age technology, both hardware and software.
In the course of its work, the Task Force became more deeply convinced that information technology when creatively applied and appropriately integrated will help meet three fundamental goals:

To improve the quality of learning.
To increase equity of opportunity.
To ensure greater cost effectiveness.

The Task Force report notes that "to a large extent resistance to the use of technology in education has been reduced to financial and quality issues, rather than philosophical ones. While educational institutions have made increasingly large investments in educational technology, the technology has often been misused or underused."

Several of the negative aspects in the use of technology in education listed by the Task Force are:

Lack of planning - Technology thrust upon, purchased defensively, supplying micros without rudimentary training (students and/or instructors), etc.

Inadequate software - Considerable improvements still need to be made in quality as well as quantity of software.

Increased costs - Cost effectiveness will be a problem. Costs to students, instructors, and institutions.

Obsolescence - Obsolescence and the lack of compatability among technologies will impact implementation.

However several positive aspects were noted:

Increased effectiveness - Indications are that well planned appropriately integrated programs used by well prepared instructors are effective.

New ways to learn - The potential exists to change the way people learn.

Innovation - Innovative uses are plentiful when applied by conscientious creative professionals.

The Task Force delineates the following 5 broad uses for technology:

1) To more efficiently develop basic knowledge and skills.
2) To teach higher order concepts and reasoning skills made less difficult by technology.
3) To develop an understanding of the impact of information on society and the work place.
4) To enable teachers to work in an environment which is tailored to each student's needs and progress.
5) To develop proficiency in computers.

In summary the Task Force report advocates -

- Planning, financing, teacher education and curriculum revision.
- Research, development, evaluation and dissemination of methods to manage technological resources as well as expert systems of software.

The Task Force expects within the next 15 years that a richness of information impossible by conventional methods will be present in our society.

Other Institution Experiences

By no means all inclusive but rather indicative of actions being taken by some institutions, the following digest is offered.

Some institutions at which PCs are required or strongly recommended are:

Drexel
Virginia Tech
Stevens Institute
Franklin and Marshall
U.S.Naval Academy
Purdue
Clarkson
Dallas Baptist
Carnagie-Mellon
Lehigh
Harvard
Colby
Dartmouth
Drew
R.P.I.
Boston University

A policy on PC use generally takes one of the following forms:

- Requirement that all students purchase a PC.
- Require incomming freshmen in particular disciplines to purchase their own PC.
- Charge students lab fees to fund electronic classrooms/labs.
- First install a network capability, then require students to purchase their own PC.
- Institution to bear costs (through grants, gifts, etc.)

Each approach has its pros and cons, the key being the resources which are available at the respective institutions and the demography of the student body.

The Second Annual UCLA Survey of Business School Computer Usage (1985) with 125 schools responding to the questionnaire shows:

5 % currently (or are about to) require students to have their own PC.
10 % were recommending the purchase of PCs to their students.

85 % were maintaining a "wait and see" attitude.

The Survey showed major constraints or bottlenecks delaying expanded use of computers:

Funding (ranked first).
Space limitations (ranked second).
Lack of qualified technical personnel.
Lack of qualified faculty.
Software licensing.
Lack of faculty consensus.
Software availability.

Academic Considerations

In July of 1983 a study was conducted at Villanova leading to an

Academic Computing Plan for the university. Among the goals for computing at Villanova were:

> A commitment to providing access to modern computing facilities for students and faculty.
>
> To provide special assistance for appropriate computer use in the Arts and Humanities.
>
> To allow for the most effective provision of computing services to all members of the community, academic or administrative.

In the spirit of the Academic Computing Plan the College of Engineering established a committee to study the implications of a policy that would require entering freshmen in the College of Engineering to purchase a micro computer to be used in their course of study. The issue for the College of Engineering is not whether they should include computer use as part of the curriculum, but how to do so most effectively. It is the committee's belief that simply "tacking" on computer assignments to the existing program would be self-defeating.

Before the adoption of a PC policy, we believe that the following (by no means exhaustive) list of questions must be addressed. The questions will have a different impact on each institution, as dictated by the respectve institution and it's particular student population and mission.

If students are to have PCs in their dorm room:

- Is there sufficient wall/desk space for a PC for each student in each room?
- Is there capability for the ultimate need for data lines in each room?
- Where and how will students acquire hardware/software/supplies?
- Where/how will the PCs be stored while awaiting student pickup?
- Who will provide the staffing for issuance and inventory control?
- Where and how will students have their PCs repaired?
- If repair facilities/storage are on campus, are technical and administrative staff as well as room available?
- Do plans exist to provide voice (telephone) and data (computer) access for current and future dorm rooms?
- Will there be provision for a terminal/PC room in each dorm to accommodate those dorm students who cannot afford a PC, giving less affluent students equal access?
- Will there be an insurance policy to cover theft/loss?

- Will the electrical power supplied to the dorms be of required quality?
- Will the electrical power be ample enough to carry the load of the TV, stereo, micros, and refrigerators, in each room and/or dorm?

If commuting students are required to have a PC:

- Will there be additional computer access telephone lines for off-campus students to access the mainframe/mini computer?
- Will the commuting student be penalized by the need to purchase a modem for off-campus access which is available in the dorms?
- Will the commuting student be required to pay for telephone charges for accessing the mainframe/mini while the dorm student will not?
- Will the student be required to carry the PC from and to home?

If PCs are required:

- Will smaller students be able to handle the bulk and weight of the selected PC and peripherals?
- What components will the students be required to purchase (PC, printer, monitor, etc)?
- If a printer is not required, how will hard copy be produced?
- Will a student connect to the mainframe to print a report or assignment?
- Will a student have access to a PC printer if a floppy disk is carried by the student to the printer?
- Will there be a sufficient number of printers to accommodate the students that will require printed output?
- Will some mainframe/mini printing be necessary?
- Will all students use the same word processing packages so that term papers, etc. can be run off on university hardware?
- What impact will hardware and software obsolescence have on students and faculty?

If PCs are integrated into the curriculum:

- Will there be enough required courses effectively utilizing PCs during the normal four years of a program to justify the required ownership of a PC?
- Will there be sufficient software to support a four year program?
- Will professors require software packages (spread sheets, etc.) to be purchased by the students?
- Will there be a limit on the cost of each of these packages?

. Will there be a limit on required software purchases per major?
. Will these packages have a more useful life than for just a single course?
. Some faculty members currently may not consider cost when they select texts, what will make them consider cost when they select software?
. Will the faculty have access to training for the use of a PC in the curriculum?
. Will the faculty have sufficient access to computer facilities to enable them to employ computer technology in their courses?
. Will the faculty support the major task of implementing such a policy?
. Will the faculty feel sufficiently knowledgeable to use a PC to teach their classes?
. Will some form of released/excused time be available for faculty to hone their PC skills?
. Will a formal program be adopted by the institution to provide the necessary training for faculty and students alike, some type of a bridge program?
. Will some allowance be available for travel connected training expenses for faculty?
. What are the proprietary implications for the use/sale of faculty and student developed software?
. What are the implications of site licensing?
. Should PCs only be required in certain disciplines and not in all disciplines?
. How will upgrades to purchased software be handled?
. Who will have to pay for these upgrades?
. Can students/faculty be using different versions of the same software and have like results?
. What happens when a student's PC is inoperable? Loaner? Lease? Replacement?
. Should a maintenance contract be available to students? If so, will the institution need spare parts, technicians, extra PCs to lend the student while the PC is being repaired?

Summary

A PC decision for a single discipline will surely affect campus wide areas beyond the discipline and the decision must comprehend these implications.

Adding the cost of a PC to a student's cost of education will not add to the available pool of Financial Aid funds at the institution, nor increase the parents' available income. Who then bears the burden since Financial Aid is usually an institution wide resource?

Another area to consider is that PCs, when connected to the mainframe/ mini, become a telecommunications problem which again is an institution wide resource.

In the final analysis, the mix of students available to each institution will determine if a particular approach is the best approach for them.

Our direction is to find the best path that will enable Villanova to provide the technology for our engineering students and still meet the needs of all students at Villanova. We have made a beginning.

References

Castellan, N.John,Jr."Computers and the Shape of the Future: Implication for Teaching and Learning."ACM SIGCUE Bulletin Winter 1986 pp50-55

CAUSE/EFFECT "Drexel University - College and University Computing Environment." Sept 1985 pp 28-32.

DeWitt, Philip E. "A Machine on Every Desk." Time, Oct. 21,1985 pp71.

Donald, A. Wayne "A Successful Microcomputer Policy at Virginia Tech." CAUSE/EFFECT July 1986 pp10-14.

Drexel University "Organizing the Program" "Preparing the faculty" and "Choosing the Machine." The Microcomputing Program at Drexel University.

Electronic Learning Magazine "Checking into Requirements: Do You Need to Buy A Computer?" January 1986 pp 47.

Frand, Jason L. and McLean, Ephraim R. "Summary of the Second Annual UCLA Survey of Business School Computer Usage." Communications of the ACM January 1986 pp 12-18.

Harris, Thomas "Preparing a PC Administration Guide." Journal of Systems Management May 1986 pp 11-13.

National Task Force on Educational Technology "Transforming American Education: Reducing Risk to the Nation." T.H.E. Journal, August 1986 pp 58-67.

Ploch, Margie "Computers in Schools: Can They Make the Grade?" High Technology, September 1986 pp 44-50.

Snyder, Christy "Micro Links to your Personal Computer." Business Software Review, November 1985 pp 24-28.

Turner, Judith Axler "Business Schools Find a Theory of Information Technology is Elusive." The Chronicle of Higher Education, July 30,1986 pp29.

ACADEMIC COMPUTING: FROM CHAOS TO COORDINATION. ONE INSTITUTION'S STORY

Trudy H. Bers
Sr. Director of Research, Curriculum & Planning

Mary L. Mittler
Assoc. Vice President for Educational Services/Dean

Oakton College
1600 E. Golf Rd.
Des Plaines, Illinois 60016

This paper describes one institution's movement from a state of disorganization--even chaos--to one in which decisions about academic computing are made in an environment of information sharing, consideration of alternatives, and attentiveness to educational implications of decisions. Identifiers of chaos, consequences of coordination, and assumptions that require questioning are identified.

ACADEMIC COMPUTING: FROM CHAOS TO COORDINATION. ONE INSTITUTION'S STORY

INTRODUCTION

The purpose of this paper is to describe the progress of one institution in moving from a state of disorganization--even chaos--to one in which decisions about academic computing are made in an environment of information sharing, consideration of alternatives, and attentiveness to educational implications of decisions. While the college has not yet perfected the coordination of academic computing, we believe that information about the strides made and issues considered through the process will be of value to other institutions struggling to integrate computing into their curricula.

THE COLLEGE AND ITS COMPUTING ENVIRONMENT

Oakton Community College was founded in November of 1969 and admitted its first student class in August of 1970. Even before the first student enrolled, a Director of Information Systems had been hired, a time-sharing lease negotiated with a local High School District, and plans made for a Data Processing Curriculum. In 1970 the college purchased an IBM 360-25, then "state-of-the-art" with a 48k memory. Today the college supports an IBM Model II 4381 CPU and over 200 microcomputers in 16 different lab configurations. In addition to the Director of Information Systems, there are now 8 full-time and 60 part-time faculty and 16 professional staff dedicated to computer instruction and/or operation support. More than 20 additional full-time faculty and several dozen part-time faculty use computers for part of their instructional efforts.

Would that all had evolved in accordance with a carefully constructed, cross-institutional academic computing plan. But like so many educational institutions, Oakton has passed through a chaotic time of rapid technological expansion and is only now beginning to plan for that part of the computer age still to come.

Initially, data processing at the college was coordinated by the Director of Information Systems and the few faculty responsible for the Data Processing Program. But as instructional demand drew, and as more and more of the Director's time was dedicated to institutional computing needs like registration, personnel and payroll systems, the instructional program became more removed. This was further accelerated by the establishment of separate instructional labs and ultimately by the incorporation of self-contained microprocessing units. As micros were becoming more popular in the world around, faculty from such disciplines as art, engineering, architecture, English, mathematics and science began exploring computer-assisted-instruction possibilities for themselves and their students. Soon, Oakton had not just a single curriculum that addressed computer instruction, but many that involved computer components to a greater or lesser extent. Students too were (and are) becoming increasingly sophisticated in the use of computers, and this pulled demand even more. Finally, in 1985 the current college president, Dr. Thomas TenHoeve, made the coordination of academic computing an institutional priority and an Academic Computing Committee was charged with beginning the process.

At this point, it must be said that other attempts had been made to organize the computing operation at the college. An academic computing analyst had been hired by the Director of Information Systems and one-half of a second analyst's time was dedicated to this use. Other academic computing committees had come and gone, largely user groups that concerned themselves with managing the many problems that seemed to arise daily as the whole order of computer use at the college grew. Finally, however, the demands clearly exceeded available personnel time and so when the current academic committee was formed, the academic analyst was a charter member, but the responsibility for coordination was more widely spread.

The Committee began its work by thoroughly assessing the college's current computing environment. Hardware, software, personnel attitudes, curriculum involvement--all were studied with an eye towards determining what truly was the state of academic computing at the institution.

INDICATORS OF CHAOS

Through the course of the year, a number of specific problems were identified which, taken together, clearly indicated chaos. In no particular order, problems included:

1. Uneven faculty knowledge of and willingness to use computers. Most faculty, with the obvious exception of data processing instructors, had been left to their own discretion to learn--or not learn--the rudiments of computer literacy,

ways to incorporate computers into their instruction for demonstrations or class assignments, and software available in their fields. An exception was the accounting faculty, who were told they would be required to use computers in their instruction and were informed an accounting laboratory was being equipped for their courses. An untenured faculty member was given responsibility for planning instructional uses of the lab and holding workshops for his colleagues. Confusion over his exact role and his termination due to declining enrolment in the program exacerbated the confusion surrounding this lab and discipline, in particular. In other disciplines faculty who were reluctant or resistent to the use of computers were able to mask their concerns since clear expectations for them were not established, although there was a great deal of talk about the need to use computers in instruction.

2. Confusion over course and curriculum contents. Individual disciplines began to create computer courses, each course tailored to the approach and discipline-specific contents of the field. For example, the math department developed a number of computer science courses as either stand-alones or to be taken in tandem with other math courses, and they also established math courses that focused on software for mathematics applications or scientific programming. The math department worked with the business faculty to develop a transfer computer science course that would meet criteria established by most of the state's public senior institution, all of this without the knowledge of the data processing faculty, who then wanted to develop such a course themselves. The accounting department developed a one-credit course for accounting applications software and began to discuss teaching Lotus 1-2-3 in other accounting courses, and the office systems technology faculty initiated courses in word processing. Though all these courses were approved by the college's Curriculum Committee, it was not until the spring of 1986 that people began to realize the overlap in content, and the fact that students might be required to take courses under discrete discipline prefixes (DPR, ACC, MAT, OST, CSC) that in fact were largely duplicative. Since each program wanted to add its own computer course, the probability for duplication grew.

3. Levels of student knowledge. The college is located in an affluent area, and high schools and grade schools are equipped with modern data processing equipment. Fewer and fewer students, especially young ones, were entering the college without any knowledge of or experience with computers. Hence instructors faced classes in which students had an enormous range of computer expertise, and struggled with the amount and type of instruction to offer.

4. Administrative problems. A variety of problems relating to the supervision, use, funding, physical space, and staffing of computer laboratories began to emerge. Most assumed the college was committed to providing students with space, equipment and assistance to work on and complete class assignments that required a computer. Thus open lab time and adequate help were deemed essential, even though the college was never asked explicitly whether the assumed commitment was real. This is a continuing and crucial issue, to which we shall return below.

5. Blurring between administrative and academic computing. Several curricula integrated computing into courses and requirements, and departments began offering courses in software applications such as word processing, spreadsheets, and data bases. Simultaneously a number of administrators and their staffs, as well as faculty, began using software packages to facilitate and enhance their work. Questions began to be raised about whether and the extent to which computer center staff could and should provide support to faculty using software applications to manage their teaching (as opposed to using them for direct instruction) and to administrators and staff using software.

6. Faculty / staff access to computers for class preparation and professional development. As the college grew more active in urging faculty to integrate computing into their courses, faculty in turn began to request computers to use for classroom preparation and professional development. Division offices were equipped with microcomputers, but faculty competed for their use with division staff using equipment for word processing. Furthermore, faculty complained that the noise and lack of privacy encountered in using division computers interfered with the effective use of the equipment.

7. Competition for laboratory space. Initially the college developed computer laboratories for credit programs. Recently, however, two other sectors of the institution have begun to claim access to the labs. These sectors are the Institute for Business and Professional Developement (IBPD), organized as a profit-making subunit whose purpose is to provide special courses and seminars for business and industry, and MONNACEP, a college - high school consortium providing continuing non-credit education for adults. Both offer a variety of computer education courses and seminars, and expect to use the college's labs, software and, frequently, lab staff. The president views clients of these groups as students with equal claims to the institution's resources, though costs of equipping and staffing labs typically come from the credit programs' budgets. Confusion about the definition and implications of offering equitable access to all students has grown.

8. Criteria for decisions about computers. Keeping up with rapid changes in computer technology became a challenge and, for a few people, an avocation. These individuals prided themselves on knowing when a new model of computer was going to be introduced, its capabilities, and its prices. Sometimes their infatuation with the latest technology and the fun they derived from learning new equipment and software interfered with the orderly introduction of computers into courses and curricula. For example, information about a soon-to-be-announced new Apple prompted cancellation of an equipment order for older equipment that would, nevertheless, serve the instructional purposes for which it had been selected.Concern became evident when faculty expecting equipment for use in the fall term were informed that different equipment was going to be ordered, but would not be available until well into the spring term. The issue was not whether the new equipment was satisfactory, but whether or not implications for the academic program had been considered when the cancellation occurred.

Any number of the concerns noted above could have been managed, especially given general understanding that the introduction of radically new technology in the world of education and management is usually somewhat erratic and loosely planned.

The combination of concerns, however, made it clear that the institution had lost control of computing in the academic area, and needed to address more systematically issues of training, curriculum, hardware and software acquisition, staffing, and facilities as they affected students, teaching and learning.

CONSEQUENCES OF COORDINATION

Many consequences of the movement toward coordinating academic computing have become apparent. In retrospect it is surprising--indeed, embarrassing--to acknowledge that these were not built into the regular routine of the college much earlier. The explosive growth of microcomputing technology in the last 5 years, urgency to begin using computers in several disciplines, availability of funds to build and equip labs, and willingness of staff to plunge in and provide technical support without a comprehensive plan, probably go far to explain how the college had managed (the term is used loosely) to move as far as it had in the area of academic computing.

The literature of innovation suggests that the period during which an organization adopts a major innovation or undergoes radical change is typically characterized by disregard for system and routine, trial and error responses to perceived needs, and reactive crisis-directed management. Only after innovation or change has taken root will the organization begin to address the messiness, weed out what doesn't work, and begin to regularize processes that had developed ad hoc.We suggest that the consequences noted here mark the college's movement from a phase of rapid change to one in which computing is being organized or coordinated across the institution. Earlier, a plan would probably have hindered the excitement and commitment to get on the computing bandwagon; now, a planless state would impede further progress because energies would be depleted and frustration fostered through the constant efforts to react to immediate problems.

Among the primary consequences of coordination, then, have been these:

> The development of a temporary position for Coordinator of Academic Computing, filled by a faculty member given release time for these responsibilities. A freeze on adding staff positions and uncertainty about the most appropriate level and responsibilities for this person prompted the decision to establish the role on a pilot basis.

- A faculty colleague who understands classroom dynamics, student characteristics, and instructional needs, and whose explicit charge is to work directly with faculty to help them maximize the effectiveness of computing in the curriculum.
- A plan to coordinate the scheduling of labs for all potential users, and an explicit order of priority designating which users could lay claim to the space.
- An inventory of instructional hardware and software, and an easy process for continuous updating.
- Targeted funds to provide faculty with release time to develop core computer courses that will serve a variety of disciplines and eliminate much of the duplication noted above.
- Sharing of information about equipment being requested so that individual departments can discuss sharing equipment or at least ordering compatible equipment to increase its versatility across the college.
- Clearer information on staff needed to support computer laboratories.
- A forum for the discussion of computer needs as well as the discomforts many faculty still have with respect to using computers for instruction or for instructional management purposes.
- Linkages between strategic planning and annual budgeting that enable the institution to establish clear goals and objectives for academic computing and to specify the resources required to achieve these goals and objectives.

ASSUMPTIONS TO EXAMINE

In the course of its deliberations the Academic Computing Committee recognized that many assumptions upon which individuals were basing recommendations and decisions were not necessarily shared throughout the college; were not explicit even to the decision-makers. Committee members began to identify the assumptions underlying their discussion, and to clarify those which required affirmation or clarification. At least four major assumptions were discussed; at this time the Committee is still seeking clarification, but recognizes that the act of questioning is by itself a contribution to helping the institution address issues and concerns of academic computing.

The primary assumptions that have come to the fore at this point include, first, the assumption that faculty do indeed wish to introduce academic computing into their courses. An early draft of the college's Strategic Planning Committee's recommended strategic goals included a statement that computing should be introduced across the curriculum. A number of faculty reacted strongly against the implication that computing was appropriate for all disciplines and courses. The strategic goal finally approved added the proviso that computing was to be introduced where appropriate, appropriate being left undefined. The active resistence of some faculty and the passive resistence of others, who have simply ignored any opportunities to learn about computing, further indicate that many faculty are not anxious to learn about or use computing.

The second assumption is that the college is obligated to provide equipment and help to students for out-of-class assignments, whether in data processing or other courses, that require computers.Two views are possible: one, that computers are similar to dictionaries, typewriters, and paper; that is, equipment that is necessary but left to each individual to provide. The other view is that the college is obliged to provide students with the place, equipment, and help to work on their assignments, much as any institution of higher education provides a library with basic references and collections for students' research assignments.

The third assumption is that all students are equal. We have referred earlier to various sectors of the college that offer computing instruction. Virtually the whole burden of equipping and staffing computer laboratories has been borne by the credit programs and instructional support services, yet some believe that individuals enrolled through the IBPD and MONNACEP should be given equal access to computer labs. The problem, especially, is that credit courses typically last for 16 weeks, while IBPD and MONNACEP courses are of shorter duration and require less homework.

The fourth assumption is that state-of-the art equipment and software is really required in all areas. Some are beginning to argue that older microcomputers and early versions of software are adequate for certain instructional purposes, and that the apparent urgency always to acquire the most recent software or newest equipment results in decisions that may not serve the instructional program and students most effectively.

THE PRESENT

Where are we then? Clearly we have much to do. We need yet to develop a master plan; we are in the process of developing a usage policy for the many labs the college has; we need to decide about the placement and reporting lines for the Coordinator of Academic Computing. Yet we have accomplished much: administrators and faculty have a person to whom they can bring their instructional computing concerns; we have Academic Analysists to lend technical support and expertise to the instructional program; we have a Director of Information Systems who provides the broad overview and field specific information needed for prudent acquisition and usage decisions. We are not finished yet, but we are at least confident that the world of chaos is behind us, and the time of coordination is now.

Exploring the Educational Opportunities of an Interactive Video Based Information System

Mary G. Miller
Virginia Polytechnic Institute and State University
Blacksburg
Virginia

Abstract

In the future, educational institutions will need to look to technology to help serve the needs of clientele. One of the technologies which offers many advantages to educators and students is Computer Based Interactive Video (CBIV). The capabilities of CBIV provide an environment that can offer students complete control of the learning pace and depth of presentation. Studies indicate that students working in this environment often learn more material in less time. In addition, the systems offer flexibility as to when and where a course can be offered.

As we approach the twenty-first century, we will need to consider alternatives to the traditional classroom setting. Information systems based on CBIV can provide some of the alternatives which should be considered.

Exploring the Educational Opportunities of an Interactive Video Based Information System

Introduction

There are many who feel the university of tomorrow will differ considerably from the university of today. Funding, sufficient numbers of qualified instructors, changing demographic profiles, new technology, and external degree programs will all affect our institutions in the future. Indeed, the entire educational system will be faced with many challenges as we approach the twenty-first century.

For our educational institutions to meet these challenges, many changes will occur. We will need to develop partnerships with businesses and industry, provide flexible programs to meet the needs of the adult learner, develop consortiums to pool resources, and utilize technology to the fullest.[1]

Two technologies which promise to provide aid for educational endeavors are the optical laser disc and the compact disc. These two technologies incorporate the highest information storage density available today. In addition, these storage mediums are convenient in size, provide excellent reproduction quality and offer the greatest durability of any audio visual system.

When these superb audio visual technologies are coupled with a microcomputer, a very effective instructional tool emerges. One that is both flexible and robust. One that can multiply the efforts of the best instructor, at varied hours, and in various settings. Indeed, one that can enhance the educational institution of the future.

This instructional tool, an information system, is capable of storing vast quantities of information in the form of slides, motion video, high resolution graphics, audio, and text. The system can retrieve information quickly and respond with a tailored learning session for each user.

The Information System Components

The major component of this information environment can be described as Computer Based Interactive Video (CBIV). A brief discussion of CBIV systems and terms follows.

Interactive video is defined to be "any video system in which the sequence and selection of messages is determined by the user's response to the material."[2] Although an interactive video system can use videotape or videodisc, a videodisc provides benefits in search time and durability and will be considered for this discussion.

The videodisc, or optical laser disc, is a remarkable medium. The material is both recorded and retrieved with the assistance of a laser beam. The information is stored in the form of tiny pits measuring a mere 0.4 micron across and 0.1 micron deep. The track is recorded in a spiral from the inside to the outside of the disc, and the distance between each section of the track on the disc is approximately 1.6 microns. This extremely high recording density means that a 12 inch disc can store up to 54,000 video frames. These frames may be accessed individually, providing a visual database equivalent to 675 slide trays, or they may be played at 30 frames per second, providing 30 minutes of motion video per disc side. In addition to the visuals, the videodisc provides two high fidelity sound tracks. These sound tracks provide audio capabilities for motion video which may be played in stereo or may be used independently, providing two distinct messages with each motion segment.

In the standard recorded format there is no available audio for still frames. This deficiency has been addressed by two manufacturers, EECO and Pioneer. Both the EECO system and the Pioneer system require added hardware to decode and playback audio messages previously encoded on the videodisc. The trade-off for both systems is the lower number of video frames available for visuals and the higher cost of producing the disc. But, if interested in providing a large database of slides with 10 - 20 seconds of explanation on each, the trade-offs may seem minimal.

Interactive Video Levels

Interactive video systems are classified into three levels, according to the manner in which the videodisc is controlled. A level one system consists of a videodisc player, a remote control, and a television receiver. With a level one system the user may use the remote control to branch to predefined chapter stops. The amount of interactivity is limited by the functions of the remote control.

Visually, a level two system resembles a level one system. The only distinction is the player. In a level two system, the player has an internal microprocessor which can be programmed to perform a certain playback sequence and respond to viewer choices during the program. The program which controls the videodisc is either previously encoded on the videodisc and automatically dumped from the disc to the player when the player is started or programmed manually via the remote control unit into the player's memory. Once the program is in memory, the player's microprocessor executes it. The program controls the videodisc while also accepting input from the user through the remote control. Based on the input value, the player may advance or review specific material on the videodisc according to the program's instructions.

In a level three system, the videodisc is controlled by an external computer. The computer can be a micro or a mainframe. The important point to remember is the computer itself contains the program which responds to user input and causes the player to perform accordingly. Thus, the videodisc player is simply a peripheral to the learning system, providing a large database of audio visual material. This type of system lends itself to the most sophisticated interactive applications.

It is within a level three configuration that all benefits of computer assisted instruction (branching, user controlled pace, lesson management, record keeping, and feedback) are joined with the benefits of television (color, motion, realistic images, sound, and emotional impact). These two mediums working together provide a learning tool more powerful than either component.

Options

With a level three interactive video system as the base, additional technologies can be added, as needed, to extend the information environment. Any peripheral, such as a light pen, bar code reader, or special key pad may be added, but a few are especially advantageous.

Touch screens offer additional user control. They provide an alternative to keyboards and light pens and are especially helpful in simulations. By touching the screen, a user can indicate how far to turn a dial or the exact placement of a part.

A graphic overlay board is often common in CBIV systems. This added hardware permits high-resolution graphics to be laid over video or slides. With this capability, graphics can be used to "point-to" or "highlight" specific areas. In addition, data that is quickly outdated can be stored on a floppy or hard disk, rather than permanently placing date-sensitive material on the videodisc. At delivery time the graphic information is placed over a portion of the video and the end result is a complete picture. The use of graphic overlays in this manner can greatly increase the life span of a videodisc. However, it should be noted that the addition of this capability not only requires the overlay board but an analog RGB monitor as well.

In addition to the audio capabilities of the videodisc, several hardware options are available to provide supplemental audio or "voice over" capabilities. These include "voice" boards which produce either a digitized voice or a synthesized voice on the compact disc. Although these options represent a wide variety of audio playback quality, a wide range in price, and varied storage requirements, the benefit to the presentation is the same: audio may be played throughout the presentation, and not only when the videodisc is in motion. Directions, feedback, and remediation may all be presented orally, providing opportunities for a more effective presentation.

Perhaps one of the most exciting add-ons to a CBIV system will be the CD-ROM (compact disc read-only memory). The combination of these two technologies will offer students a powerful learning center. Information will be available in a stand-alone setting that was only available previously from online database services or from an unmanageable amount of physical information. Imagine a student surrounded by 400 trays of slides, a 10 minute motion video, 50 cassette tapes, and 2,000 journal articles investigating a specific topic. The vast quantities of information available in a CBIV system coupled with the 600 megabytes of data stored on a 4.7 inch optical disc could make this student's task manageable. The added manageability of information which these technologies offer will have great impact on the learner, and the phrase "freedom of information" will have new meaning.

The data stored on a CD-ROM disc can represent the equivalent of 200,000 pages of text, 1,000 graphics, 75 hours of spoken material, or any combination of all three. In addition, because the information is stored strictly in a digital format, any number of computer programs, with test data, can be stored. In all, the equivalent of 1,500 floppies will fit nicely on the small surface.

Although few CD-ROM applications exist today, the future promises many, and the education setting can only wait with anticipation. Currently, medical and financial databases are available, as is the Grolier's Encyclopedia.

One example of CD-ROM already in use is at the Lippincott Library at the Wharton School of Business, University of Pennsylvania. They installed the Compact Disclosure CD-ROM disc on their IBM PC XT. The disc includes financial information for more than 10,000 public companies based on reports filed with the U. S. Securities and Exchange Commission. Students have been quite positive about the availability of information versus using the microfiche system.[3]

Whether the CD-ROM technology is used in conjunction with a CBIV system or as a solitary information system, the impact within learning institutions will be substantial. Many feel the CD-ROM will replace traditional text in the future. Barry Richman, a veteran of the publishing industry, writes, "The underlying reason that CD-ROMs and other dense media are likely to replace traditional print is, as usual, economic. Dense media have the inherent characteristics necessary to cure some of publishing's greatest problems - excess inventory, short product life, high distribution costs, wasteful product returns, and insufficient shelf space to give new products a chance to thrive. These are chronic suffocating problems for which no solution can be found in traditional print forms."[4]

The Learning Environment

A CBIV system can be a very responsive teacher. Not only can it provide the student with the assigned material, it can explain difficult areas by giving additional examples, correcting mistakes, providing guidance, defining terms, repeating a section, showing a process in slow motion, or referencing additional reading material. In essence, a student can have complete control over the pace of the presentation and the depth of explanation.

The learning environment is one that permits systems to be effective from many locations. Courses may be offered through a main lab on campus, the university library, or a setting local to the student, such as a community library. Students need not be present in one location at a specified time in order to participate. This flexibility in when and where a course can be offered will be important in the future, with many campuses already feeling the crunch for classroom space.

The system can closely monitor a student's progress, recording whatever information an instructor feels is important. For example, the interactive video system designed to teach cardiopulmonary resuscitation (CPR) for the American Heart Association, consists of a videodisc, monitor, and a computer linked to a lifesize mannequin. Electronic sensors embedded at strategic locations in the mannequin automatically measure and evaluate the student's performance. When the student completes an assignment, the face and voice of the instructor reappear, telling the student how well he or she is doing, and suggesting improvements, but the course is actually being "taught" by the victim. Feedback continues until the student has mastered all aspects of CPR.

The effectiveness of such a learning environment has been documented in several studies. A recent study conducted by IBM evaluating traditional teaching methods versus a CBIV environment of one system with one student (one-on-few) and one system with three-to-five students (one-on-many) concluded:

> "Student learning gain scores were significantly greater in the one-on-many and one-on-few modes than in the traditional classroom lecture-based mode (31.3 percent greater in one-on-many and 50.0 percent greater in one-on-few). Differences between one-on-many and one-on-few were strong, but not statistically significant.
>
> With the use of interactive videodisc, the percentage of students reaching mastery (80 percent on the post-test) increased over 300 percent."[5]

Studies indicate that not only do students learn more, they complete the material in less time. Additionally, students report that they enjoy the added flexibility of the material.

Educational Opportunities

Throughout the university many applications exist for use of this technology. A few of the more amenable areas are:

1) Archival Applications - Slide Collections

   Thousands of slides exist within a learning institution. But specific sets can be difficult to locate and expensive to duplicate. They fade and are easily lost or damaged. For this reason, many slide sets are often unavailable to the learner.

   A disc collection can be an excellent way to provide access to valuable slide collections.

2) Instructional Applications

   Many possibilities exist for developing instructional material. Successful applications have included career guidance, foreign language instruction, science laboratory simulations, and tutorials.

3) Information Applications

Information that is repeated many times with little change can be offered to students or prospective students from a system. This treatment is especially effective when the questions are predictable. Programs in this area could include information on individual colleges, programs of study, campus life, financial aid, activities on campus, and local housing.

Providing an information system of this nature can save valuable staff time and provide students with improved services.

4) Training

This area is quite adaptable to the CBIV environment. Training packages can be developed for students, faculty, and personnel. Several good commercial packages are in existence which train listening and interpersonal skills, maintenance and trouble shooting, CPR and first aid, and many other "how-to" applications.

Cost vs. Benefit

There are several costs involved in delivering information in this manner. The two obvious costs are equipment and development, with the development cost being the greater.

The equipment cost for delivery stations continues to decline. Varied prices exist throughout the industry, but several manufacturers offer a level three CBIV system in the range of $5,000 to $7,000.

Development cost includes all standard costs that would be incurred to produce a video tape plus the course design, disc production, authoring, and testing.

The cost of producing a disc from tape is not the major cost, as many people believe. A disc can be pressed for approximately $2,000, with each additional copy costing only $20.00. Thus, it is easy to see that an application which serves a wide audience can be cost effective.

If you consider developing a CBIV course, there are a few questions which can help you determine the appropriateness of the material.

- How many people need the instruction?
- How many different audiences can use the material?
- Will the content be stable?
- How much information will be used and preserved?
- How much money and time will be needed for development?
- How much money and time will be saved by delivering the course in this manner?

The answers to this short survey will help you determine if a course or training program is a good candidate for development. If the correct course is selected, you can be sure the benefits will far exceed the cost.

The Future

Samuel Dunn, in his article, "The Changing University," indicates a number of situations that will change within universities as they endeavor to survive in the information age.

The Faculty:

> "The model of the professor as the manager of a mini-educational system involving staff support, hardware, and courseware appears to be a promising one for meeting changing academic and economic goals."

The Education:

> "Tomorrow's university will provide both education and training."

The Curriculum:

> "... the citizen of the information society, will need to know much more about the interactions of various bodies of knowledge. The modern world is complex and interconnected .... A narrow view of life, discipline, or career is inappropriate in these circumstances."

The Course:

> "The student would enroll for a course or module, then go to an assigned classroom for initial instructions and diagnostic tests covering the course material. On the

> basis of the diagnostic results, a personalized course of study would be prescribed that would involve interaction with a collection of courseware materials, submission of papers, attendance at occasional lectures given by the professor, individual consultation with the professor, and examinations to demonstrate mastery."

The Student:

> "Today, more than one-third of all full-time and part-time college students are over 25. In the future, most students will be over 25 years of age. The older learners will, on the average, be more highly motivated than the 18 to 22-year olds. They will want to have easy access to courses or programs, to move through the educational experience as rapidly as possible with maximum learning, and to receive certification of their new knowledge and skills."

For many of us the future is here; our institutions are already experiencing many of the situations described by Dunn. But, for all of us the future will be here. If we are to meet the needs of our future clientele, support our faculty with the proper tools, and expand our services, we need to look to technology for support. The information system based on the CBIV environment should be one of the technologies we consider.

Footnotes

[1] Samuel L. Dunn, "The Changing University - Survival in the Information Society," FUTURIST, August 1983, pp. 55-60.

[2] Nicholas V. Iuupa, A Practical Guide to Interactive Video Design, (White Plains, NY: Knowledge Industry Publications, Inc., 1984), p. 5.

[3] Mark J. Welch, "CD-ROM Arrives," InfoWorld, May 1986, pp. 43-44.

[4] Barry Richman, "Dense Media and the Future of Publishing," CD ROM The New Papyrus, (Redmond, WA: Microsoft Press, 1986), pp. 445-452.

[5] Judith Vadas, "Results from IBM," The Videodisc Monitor, October 1986, pp. 16-19.

References

Currier, Richard L., "Interactive Videodisc Learning Systems," HIGH TECHNOLOGY, November 1983, pp. 51-60.

Dixon, Bradford N., "The Grolier Electronic Encyclopedia," CD-ROM Review, Premiere Issue 1986, pp. 10-15.

Dunn, Samuel L., "The Changing University - Survival in the Information Society," FUTURIST, August 1983, pp. 55-60.

Iuupa, Nicholas V., A Practical Guide to Interactive Video Design, (White Plains, NY: Knowledge Industry Publications, Inc., 1984), p. 5.

Laurillard, Diana, "Interactive Video and the Control of Learning," Educational Technology, June 1984, pp. 7-15.

Richman, Barry, "Dense Media and the Future of Publishing," CD ROM The New Papyrus, (Redmond, WA: Microsoft Press, 1986), pp. 445-452.

Rhodes, Dent M., and Janet White Azbell, "Designing Interactive Video Instruction Professionally," Training and Development Journal, December 1985, pp. 31-33.

Vadas, Judith, "Results from IBM," The Videodisc Monitor, October 1986, pp. 16-19.

Welch, Mark J., "CD-ROM Arrives," InfoWorld, May 1986, pp. 43-44.

IMPROVING MICRO-BASED INSTRUCTION WITH A LAN

Joseph A. Middleton
Director of Data Processing

Lehman College
of The City University of New York
Bronx
New York

Lehman College has installed some two hundred microcomputers for instructional use, in classrooms or labs of fourteen to twenty machines each. After over a year of planning and refining the specifications, funding was provided in the Spring of 1986 for installation of a LAN to support two classrooms at the Academic Computing Center, each equipped with IBM PC's, in the Spring of 1986. The objectives were to improve the effectiveness of Center staff, by reducing the time required for distributing and collecting diskettes and for maintenance of the diskette library; and secondly to facilitate access to peripheral devices of which few are available (letter quality printer, hard disk, hard copy graphics). This presentation will review LAN specifications (what and why), implementation decisions for LAN management, and preliminary evaluation based on the first semester of use (Fall 1986).

Microcomputers in Instruction at Lehman College

Lehman College has a history that spans less than two decades, having become a senior college of the City University of New York in 1968. Prior to that time the facilities and faculty that became Lehman had been developed as the Bronx campus of Hunter College. The College currently has an enrollment of about nine thousand students, all commuters, many part time (FTE count is under seven thousand), many working to pay their way through school.

Lehman has consistently emphasized the liberal arts as central to its undergraduate curriculum. The presence on the campus of the Lehman Center for the Performing Arts, and of the Art Gallery, offer a unique environment for students in the music and arts programs. Other programs have developed supportive relationships with Bronx institutions to enhance the value of their students' years at Lehman, among them the health professions programs with Montefiore Medical Center and the graduate biology program with the New York Botanical Garden.

Instructional computing was not a key factor in the early development of the academic programs at Lehman. In the early eighties, thanks to an NSF grant awarded to a faculty member of the Math and Computer Science Department, it was necessary to relocate the academic computing facilities to larger quarters to accomodate equipment (particularly microcomputers) being purchased through the grant. The Academic Computing Center was developed in a ten thousand square foot open area in the center of Carman Hall, one of the classroom and faculty office buildings on the campus.

The newly relocated Academic Computing Center continued to provide access to the City University Computing Center (CUNY/UCC) both via terminals (for Wylbur and VM access) and batch (using keypunches and RJE stations), and added Apple-II+ and IBM-PC microcomputers. Faculty in the Math and Computer Science Department desired to teach their courses in classrooms equipped with micros, hence the new space was divided into staff offices, some classrooms (for micros), and open space for terminals, keypunches, and a few additional micros.

As the demand for use of microcomputers grew, so did the number of classrooms and the number of micros. The initial IBM PC equipped classroom at the Center was supplemented in each of the last two years with one additional such classroom, for a total today of three classrooms equipped with IBM PC's. The equipment (micros and printers) for the additional classrooms was purchased by the Continuing Education program to meet the demands of their increasing course offerings. In addition to the classrooms in the Academic Computing Center a classroom was equipped with IBM PC's adjacent to the Math and Computer Science departmental and faculty offices. The Apple-II+ micros have been phased out, replaced with Apple Macintoshes. One classroom so equipped is located at the Center and a second at the Math and Computer Science Department.

The addition of the Macintoshes was funded by the City University's initiative over the past three years to assist the Colleges in the expansion of computer resources for instruction. The intent is to encourage a substantial increase in the number of students introduced to the use of computer resources during their college careers as well as to encourage the introduction of (or substantial enhancement of) computer support for courses not previously making use of computers.

Last year interactive academic computing also was substantially enhanced; to the twenty-seven Wylbur terminals at the Center (connected via multiplexer to CUNY/UCC) were added fifteen terminals connected to a newly acquired DEC VAX-11/750 (installed at Lehman).

Two dozen IBM PCjr's were also installed at the Center last year, increasing microcomputer support available for introductory courses. These are installed in the public micro lab area, and are used primarily by students in introductory Computer Science courses. They also serve as overflow lab space for students using two PCjr equipped labs elsewhere in the building, one at the Writing Center (which provides assistance and tutoring for students on their writing projects) and another used by the Division of Professional Studies (which assists students interested in teaching as a profession).

The Downside: Too Many Diskettes

With the rapid expansion of academic computing facilities came the usual stresses of such growth -- for Center staff in adapting and adjusting to new tasks and services to be provided, and for users in learning new tools and selecting among growing options those facilities that would best support their research or their coursework. One new task that grew, to the detriment of other needed services, was the maintenance and distribution of software diskettes for the microcomputer users at the Academic Computing Center.

For each microcomputer in the Center there are of course several software packages, including the operating system, one or more word processing packages, spreadsheet, database, languages, statistics -- some purchased software, other items provided by faculty for use by their students. Some packages require more than one diskette to provide access to the full capabilities designed into them. With the increase in the number of microcomputers, and the addition of new software, the diskette library to be maintained grew from a hundred or so diskettes to over a thousand, with each addition to the library requiring from a few dozen to a hundred plus additional diskettes. Necessary were an original master copy of each package, in duplicate, and a copy to be handed out to the user for each micro, the total number of copies limited by the number of licenses for the package or, for site licensed software, by the maximum number of micros likely to be used simultaneously with the same package (for example, one classroom plus a few additional users doing their own work). A few extra copies of each package were needed to be able to quickly replace a damaged diskette.

This arrangement would work fine if sufficient staff could be assigned to diskette librarianship. The Center had implemented a common scheme to ensure that diskettes were not lost: any user arriving at the Center to use a micro would exchange an ID card for the necessary software diskettes, and would return the diskettes and pick up the ID card on the way out. Loss of diskettes was hence not a problem. The tasks that became problematic however were the distribution and collection of diskettes, and ensuring that the diskettes were in good condition.

Distribution and collection of diskettes required constant staffing at the software library counter (which was located at the entrance to the Center, to make it as convenient as possible), with extra persons at class change time; even so, the perceived delay on the part of users having to stand in line coming in and going out of the Center at busy times was a constant source of frustration. Users of course expected more immediate service. Staff were interrupted from other duties for ten or fifteen minutes each hour to provide extra help at the diskette library counter.

Ensuring that the data diskettes remained in good condition also meant both delaying a user in starting a work session and interrupting a staff member to look into the problem. Occasionally the diskette itself was damaged, at other times a user would inadvertently write on the software diskette instead of on their data diskette. A damaged diskette was then identified by the next user attempting to work with it, not by the user who damaged it, and at least minimal staff assistance would be requested to confirm that the problem was the diskette and not the micro or a user error. Checking each diskette every time it was returned to ensure that a damaged diskette was never loaned out would be impractically time consuming.

As a result of the additional attention the diskette library required there was a decrease in staff support available for other user services, such as troubleshooting minor hardware problems or providing consulting on software available or assignment requirements. In our case funding for additional student help, the least expensive source of additional staffing and an acceptable level of staff support for routine care of the diskette library, was not forthcoming. In order to provide one additional part time student for the hours the Center is open the cost is approximately $10,000 per year, and it must be noted that a single additional part time student would not have assured fully eliminating the difficulties inherent in managing the diskette library.

The Proposed Solution: What We Asked For

As the Center had expanded in 1985, fairly well keeping itself state-of-the-art with the addition of IBM PC's, Apple Macintoshes, a Digital VAX, IBM PCjr's "hosted" by the VAX, and the VAX networked to the CUNY/UCC IBM systems, the staff had also considered a network for the micros an appropriate additional step. However there was no obvious choice for a network in an academic setting, in fact it was not clear exactly what capabilities should be expected of such a micro network. During the year staff members read articles, discussed products with vendors, and began documenting features and services that a network should provide. In particular they found that networks intended to address business needs might not support the several dozen micros used simultaneously in an instructional lab; and that many networks required booting the micro from disk and then running the network software as an application. By early 1986 the objectives for a network in the Academic Computing Center were fairly clear, and when funding was made available the specifications were written and submitted for bidding.

A key aspect of the introduction of a Local Area Network would be the accessibility of micro software from a file server, eliminating the need to distribute diskettes for such software. In order to meet this objective the LAN would have to provide a **remote boot** feature, that is the ability for the user to boot a workstation micro without a DOS or program diskette. Both operating system and program would be available from the server, and the user would need only provide the data diskette. (The individual PC's would of course also continue to operate independently of the network when necessary to run software not available from the file server.) As an added benefit, the network would share hard disk space, thus providing access to large shared data files; and would permit sharing of other peripherals, such as a letter quality printer, laser printer, or plotter, without requiring the user to move to a specific microcomputer having these attached devices, thus alleviating the scheduling difficulties that accompany use of such special devices attached to a standalone micro.

The specifications developed reflected these major concerns, and also incorporated other requirements that were designed to ensure both the successful implementation of the project and the viability of the network for enhancement and growth over the next few years. Not finding a single vendor's system that off-the-shelf would provide all the desired features, the specifications were written to reflect required performance and features for the user, and not specific manufacturers or models, nor even such things as transmission media or speed, protocol, or network topology. The expectation was that a distributor would package an appropriate selection of equipment and software to address our requirements, if necessary customizing the proposed solution.

The specifications are a nine page document, hence they are not reproduced here; however the major requirements written into them other than those noted in the preceding paragraphs follow.

The microcomputers (IBM PC's with 256K memory and dual floppy drives) and printers (some parallel, some serial) were already installed. The successful bidder would provide **a complete network** -- supply all boards, cabling, network server, network software, other equipment and supplies, and completely install both hardware and software, as necessary to connect forty of the IBM PC's at the Academic Computing Center to the LAN. The forty PC's included two classrooms, one with 14 and the other with 16 machines, eight micros located in the open lab area, and two micros in staff offices to monitor and manage the network.

It was intended that once the bid was awarded, and the proposed equipment and software delivered and installed, we would have an operational and usable network. A maximum time limit of two and a half months was allowed from issuance of the Purchase Order to complete installation of the network.

Although the items proposed could be from multiple manufacturers, they were to be supplied directly by the successful bidder, and the supplier was required to provide on-site **warranty** and maintenance service. We did not want to be in the position of having to assemble pieces of the project from various vendors and suppliers, nor of having to deal with depot maintenance, either of which could delay implementation of the project.

To ensure our ability to continue effective operation and enhancement of the LAN, complete **documentation**, both on the equipment and software included and on its specific implementation at Lehman, as well as training of our staff and ongoing technical support during the warranty period were required.

For purposes of future **LAN expansion**, the proposal had to include the ability to connect not only IBM PC's but also XT's, AT's and PCjr's to the LAN. (Desirable, though not required, was the ability to connect Apple Macintoshes as well; no vendor was able to offer this capability.)

Software in use or planned for at the Center was specified, with the requirement that it be usable on the network. (The list did not include any proprietary software specifically designed to require a key disk; if a suitable alternative can be found to such software we use it.)

In addition to the ability to spool to **network printers**, support for interactive use of such printers was required, that is programs designed to use a dedicated printer had to be supported on the network accessing network printers. Furthermore, each workstation user was to be able to specify which of any of the shared network printers should be used for printer output.

Security was required for the network, for user files, and for software on the server. Specifically, the network had to be secure from tampering by an individual user; user files had to be protected from unauthorized access; and software on the file server had to be protected from unauthorized copying. On this last issue we were in fact specifying more security for software on the network than we could guarantee for software on diskettes.

Although we were purchasing a single network for the entire Academic Center, we wanted the ability for the microcomputers in a single classroom to share access to specific programs and data when appropriate, while giving the instructor the ability to identify individual students in the class for purposes of exchanging messages or reviewing a student's work. The specifications thus required the ability to associate a group of **"student" accounts** with an **"instructor" account**, providing to the instructor in the arrangement the ability to control a disk work area used by the class.

For most users however, including most courses, it is sufficient to provide access to the various programs on the server; hence we required the ability for **many users** to use the **same account**, accessing identical facilities, simultaneously at many stations. Also required was the ability to establish several such accounts, each providing access to unique facilities, simultaneously to several users; this would address for example the needs of introductory classes for which the instructor wished to tailor available facilities to the minimum needed for the students.

Performance was specified in terms of program startup at a workstation, requiring that a workstation boot from the server and load software from the server faster than the equivalent procedure could be done from diskettes; and that performance not degrade below this level for as many as twenty near simultaneous startups, such as might occur when the students in a class turn on machines in preparation for a class session.

Implementation: What We Got

Over twenty potential LAN suppliers had been identified, including manufacturers and distributors of most of the commonly known LANs. Many of these had discussed our requirements with staff at the Academic Center during the previous year, and had indicated an interest in bidding on the project. Others were added simply because we were aware of the alternative and wanted the best possible responses to the RFP. The major difficulty encountered by various vendors was the requirement to support a remote boot capability. Other issues of concern were workstation performance with forty stations on the LAN (and perhaps more at a later date), protection of server software, and the ability of some to provide all the required support (equipment, software, installation and training).

The selected vendor, SRS Networks, Inc., of New York City, proposed **a complete, installed network**: Novell 286A microcomputer as the server (2MB memory, 30MB hard disk), ARCNET LAN boards with the appropriate connecting "hubs" and RG-62 cabling, Novell Netware 286 SFT Level I network software, five days of installation and five days of training, at a total cost of $32,600. The requirements identified in the previous section were addressed as follows.

Each IBM PC loses nothing of its standalone capability; added to it is an ARCNET board to connect the PC to the network, with a **remote boot** PROM on the board having on it the network shell software, sufficient to access the server and boot the workstation if the PC is booted without a diskette in the local drive.

The bid was awarded at the end of June, with the actual Purchase Order written in mid-July. The equipment and software arrived in August, with installation occuring during most of August, training in late August and early September. The network was available for the start of classes a week after Labor Day, with final acceptance of the entire installation on September 9.

The network was **supplied and installed**, with appropriate staff being assigned by the supplier for the various tasks involved -- cable installation, equipment installation, software installation and tailoring, staff training. Cabling was facilitated by the fact that cable troughs are in place around the perimeter of the Academic Center, and with the "rooms" being open overhead (the walls are in fact eight foot partitions in a twenty-foot high space) all locations are easily accessible. Other than running cables, installation of equipment consisted of putting an SMC ARCNET board in already installed IBM PC's, installing the Novelle 286A network server (an IBM PC/AT compatible machine), and interconnecting the cables to active hubs (three were used, each of these require an electrical outlet) and passive hubs (which require no electrical power).

On-site **warranty** was provided. Support was further facilitated by installation of a 1200 baud modem and Carbon Copy software on the server to permit remote diagnostics.

The manufacturer's **documentation** was supplied with each piece of equipment or software, and in addition the supplier provided online diagrams and descriptions of the installation at Lehman, which can be updated and maintained as the network changes.

LAN expansion is possible using ARCNET boards and cabling to support the IBM PC, PC/XT, and PC/AT. IBM PCjr's can be supported through a dedicated IBM PC used as a gateway to an IBM Cluster network, using JR Cluster Boards and RG-59U coax cable to connect the PCjr's.

All required **software** is supported on the network. Furthermore, access to software can be restricted based on physical workstation address, hence it is possible to conveniently and effectively restrict some software to only a portion of the network, or to make different versions of software available at stations with different hardware configurations. The Novell menu system, part of the Netware software, is used to walk the user through software selection.

The Hot Print (Advanced PC Solutions) software provides the desired interactive control of **network printers**; the Novell Netware software allows selection by the user of any of the shared (spooled) network printers.

Novell Netware software provides file **security** based on user account as well as individual file, however it only allows read and/or write access restrictions. The Hot Print software in addition permits execute only protection for software on the server.

Communication between an **instructor** and the **students** in a class can be provided via the Electronic Mail facility of the Novell software, by controlling student's access to the instructor's mail directory, and giving the instructor access to each student's mail directory.

The Novell software permits any number of users to sign on under a **Group ID**, thus permitting an entire class to use the same ID and through it access specific facilities on the network. Most users log into the network server using the Group ID "Hello", which requires no password and provides access to all the general purpose software installed on the server.

A satisfactory and consistent level of **performance** was assured by the use as the network server of an 8MHz processor with no wait states, with two SMC ARCNET LAN boards installed in the server, each connected to roughly half the network, thus providing two parallel trunks each running at 2.5 MB. Though noticeable when many stations are accessing the server, performance degradation at the network stations is not significant.

Effectiveness of the LAN for instruction

Thus the specifications were effectively addressed, and our experience thus far indicates too that our objectives in terms of improving services to instructional users of microcomputers were addressed.

The Center has continued to operate with no increase in staffing from last year. Less support is needed for distributing and collecting software from users, permitting staff to be assigned to other tasks assisting users. As had been intended, the majority of users can now enter the facility and use a microcomputer without borrowing diskettes from the Center, hence the lines of students entering and leaving the Center have all but disappeared. User response in general has been extremely positive to the ease with which they can now begin their microcomputer session and leave when they wish. Staff are more productive too in assisting users, without the hourly reassignment of one or two persons to provide extra help with software diskette exchanges at class changing times.

Faculty appreciate too the easier startup of a class session. Furthermore the availability of the hard disk on the file server has meant that options for some software which were previously not used because extra diskettes would be required can now be easily used. Similarly, data files (for example census data) can now be stored on the file server which previously were not used because they would have required multiple diskettes, a set for each student who would need the data simultaneously. Yet another positive point noted by faculty is the ease with which students can be introduced to a variety of software packages; since available software is displayed on the menu, students now more readily investigate and learn about programs not required for the course, and which they would have ignored had they been working with diskettes.

The diskette library still exists of course. Some software has not been installed on the network server (due to license restrictions); and one IBM PC equipped classroom is not on the network, hence any work done there requires diskettes to be distributed. Occasionally too an instructor will want to demonstrate to a class how to work with a diskette based standalone system, and thus requests software diskettes. The diskettes are also a backup for the network, if the LAN fails and cannot be quickly recovered the diskettes are used until the LAN is back in service.

The reliability of the network is of critical importance. No one would be well served by having software on a network server if the network frequently failed. A number of intermittent failures in the first several weeks were traced to faulty connector installations on network cables; once these problems were corrected the network has been quite stable. Only during the first month of network operation were failures severe enough to require use of diskettes for a class session, and these instances occured primarily on Saturdays, when the full time technical staff were not available to assist in diagnosing and correcting the failure. Though we have no actual counts, our sense is that fewer software failures are experienced on the network than were experienced previously with diskettes.

Conclusion

The installation of a microcomputer LAN at the Academic Computing Center must be considered a success. It provides the services that were intended -- file server for software and data, workstation booting without diskettes, sharing of printers or other peripherals. The network was installed on schedule and performs as expected. Users have received improved service, and staff are more effective though no more in number.

Noting the service and reliability thus far seen, it is our intention to continue to expand the network, adding the remaining IBM PC classroom, and also adding the IBM PCjr's on a Cluster network, bridged to the existing network and file server. Since the PCjr on the network will get its software from the file server, the single local floppy drive available will make it equivalent for many purposes to a dual drive IBM PC.

Other planned enhancements have to do solely with software improvements to the installed software and to the menus in use. For example, the Help information for the Menu system is in many instances inadequate, and by adding appropriate Help to the network menus not only is the micro LAN user helped but at the same time the need to prepare hardcopy handouts is reduced.

Key factors in the success of the project were having a clear understanding of the desired objectives, the ability of the vendor to deliver and install a complete system that could meet those objectives, and finally having the staff at the Academic Center follow up after implementation to ensure both its continued operation and enhancement.

THE CENTRAL SERVICE NODE IN A MULTICAMPUS NETWORK

THE CSU EXPERIENCE

James K. Hightower
Penelope Crane

The California State University
Los Angeles
California

The delivery of computing support services to remote users has long been a topic of interest to the university and college computing community in its need to provide economical access to sophisticated software and hardware. The advent of network access to university supercomputers has added currency to these issues once again.

In many such delivery systems politics and organizational factors have combined with uncertain communications services and costs to overwhelm the obvious economies of scale. As one of the largest university computing service networks, The California State University (CSU) has been uniquely constituted so as to have overcome many of these factors.

This paper is an attempt to portray the delivery of the central computer services of the CSU to its remote users in such a manner as to provide information useful to other multicampus computer service networks.

I. INTRODUCTION AND BACKGROUND

The California State University distributed computing network was established as a result of the 1968-69 Budget Act. Development of the distributed network began primarily with local campus and central batch computers. Telecommunications lines and associated equipment were installed allowing all campus computers to communicate with the central facility. This capacity was augmented over the years to include instructional computing at the central facility, followed by smaller local campus timesharing computers. Periodic upgrades to most equipment have been accomplished over the years. Below is a list of major computer procurements in the CSU.

MILESTONES: MAJOR CSU COMPUTER PROCUREMENTS

Date	Procurement
Prior to 1961	No Computers on State College Campuses
1961	Three Campuses Install Small Computers
1963	Twelve Campuses Install Small Computers
1967	First Campus Timesharing System Installed
1969	Regional Data Centers Installed
1969	Major Upgrade of Campus Batch Computers
1970	Upgrade of a Campus Timesharing System
1971	Central Timesharing System Installed
1972	Consolidation of Regional Data Centers
1974	Installation of Batch Computers at Four Small Campuses
1975	Campus Installation of Minicomputers for Timesharing
1976	Upgrade of Central Timesharing System
1977	First Library Transactor Installed
1979	Eleven Campuses Upgrade Campus Timesharing System
1980	Replacement of Campus and Central Batch Computers with CYBER 170/700's
1984	X.25 Network Installed to Link all Systems
1985	Thirteen campuses add CYBER 180/800's for Administrative Computing
1985	Replacement of Campus Minicomputers with Prime 9750's
1986	Upgrade of Campus Primes

Now that the computer network is installed, the functional differentiation of the nodes can be defined. The central computer systems provide computer resources for systemwide computing and EDP support activities as well as production support for the Chancellor's Office.

In the area of academic computing, the central computer systems provides campus support for:

1. Data bases which are large and/or infrequently used but needed.
2. Proprietary software which is too expensive to acquire for each campus until individual utilization of the software becomes substantial.
3. Large CPU-consuming jobs which cannot be effectively processed on a campus computer system.
4. Sharing of software and data among campuses through the data communications network.
5. Exploration of systemwide use of special purpose software which requires a research and development support environment.

The campus systems are to provide support for most of the local instructional and administrative processing requirements. Each campus has a small or medium sized stand-alone CYBER 170 Computer System for major instructional computing support and a Prime 9755 or 9950 for instructional timesharing and most have CYBER 180 Computer Systems for administrative computing.

As the largest single source of college graduates in the nation, the CSU has an obligation to adapt and expand instructional programs in order to provide graduates with skills which will enable them to participate in and contribute to the economic climate. The relatively healthy state of the California economy can be attributed largely to the heavy concentration of electronics, aerospace and banking industries - all of which are highly dependent upon computer technology. The startling growth in the personal computer industry gives credence to claims by some educators that computer literacy is becoming the fourth "R" in education.

Students in computing using courses nearly tripled, while more than eight times the number of computer and information sciences degrees were granted last year than in 1972. The CSU recognizes the need to adapt and expand its computer resources to provide graduates with the skills needed to compete in the job market.

The basic policy regarding instructional computing applications is to exploit the computing resources available through the common Central and Campus Computer Systems when feasible and cost effective. The instructional program, however, with its broad spectrum of disciplines and courses, necessitates cost effective use of computing resources in the hierarchy available.

Hierarchy of Instructional Computing Resources within the CSU

Computer	Type of Instruction	Level of Use
Micro	Beginning Programming in appropriate language	Beginning, Intermediate,and Advanced
	Special Purposes such as operating systems courses	
Mini	Software Package Use such as MINITAB and SAS	Beginning and Intermediate
	Programming Languages such as BASIC and Pascal	
Campus Mainframe	Programming Languages such as COBOL and FORTRAN	Intermediate and Advanced
	More Sophisticated Packages such as SPICE and GPSS	
	Some Analyses of Data Bases such as California Poll and ICPSR	
Central Mainframe	Analysis of Large Data Bases such as COMPUSTAT, Census and LANDSAT	Advanced (also Faculty and Computer Center Staff)
	Heavy Compute-Bound Problems such as crystal rotation	
	Use of Expensive Proprietary Software such as SIMULA and CD2000	
	Sharing Among Campuses of software and course materials developed locally	
External Resources	Use of Software and Hardware not available within the system such as Supercomputers	Mostly Advanced and Faculty
	Communication with Resources available elsewhere (sharing with other researchers) e.g., BITNET	

In order to provide for the overall objective of enabling every CSU student to acquire the computation or data processing expertise requisite for professional qualification or for further academic work in his or her chosen field, academic computing support must provide:

- Adequate computer resources to meet the computer literacy and programming needs for undergraduate and graduate education requirements in all programs where this is required;
- Adequate computer resources to meet the general instructional and research needs of disciplines requiring students to have access to a computer, where such access is generally expected and the programs of such disciplines are an approved part of the CSU curricula, e.g. access to software packages and data bases;
- A means for obtaining computer resources for those approved programs requiring specialized and/or intensive computer resources, e.g., graphics, computer science and laboratory applications; and,
- Computer resources which can augment undergraduate and graduate programs through advanced computer-assisted instructional technology.

A wide variety of programming languages and software are required to properly support the instructional program for students preparing for careers in the computing industry. In addition, applications in environmental and ecological studies, economic modeling, financial planning, plant and animal taxonomy and the social sciences depend heavily upon the statistical analysis of large data bases. Instructional requirements include:

- Multiple programming languages, e.g., COBOL, FORTRAN, ALGOL, APL, PL/I, Pascal, Modula2, ADA, SIMULA, SMALLTALK, LISP, PROLOG, SNOBOL, etc.
- On-line access with interactive software
- Continuous system simulators used in the analysis of environmental phenomena and the analysis of dynamic systems in science and engineering systems;
- General purpose system simulation software for the construction of practical models used in business, the transportation industry, and for operations research applications;
- Hardware resources to support large-scale problem solving in numerical and statistical analysis;

- High-speed graphics to permit the visual interpretation of the results of analyses and problem solutions generated by a variety of computer software, including structural, architectural and artistic design;
- Advanced workstations with high resolution graphics capabilities and sophisticated software;
- Authoring systems to help faculty develop instructional aids and to teach the use of CAI;
- Expert systems development tools to explore this new technology;
- Computing systems in wide use in higher education to facilitate the economical exchange of software with other institutions;
- A wide variety of special purpose facilities dedicated to real-time data acquisition (environmental monitoring) and process control (petro-chemical and heavy tool) applications; and,
- Intercomputer communications and file transfer capabilities for use of a variety of resources and the integration of their outputs.

II. DISTRIBUTED SERVICES

In the area of academic computing the CSU has taken advantage of its size, organization and modern technology in order to deliver computing capabilities in the most cost effective manner. This has been done through the sharing of proprietary computer software and data bases, the sharing of support and facilities for these resources and the sharing by faculty in their use and in the development of additional enhancements. This method of acquisition, delivery and support offers significant cost savings in a single price over the duplication of the cost up to 19 times. Further, even when multiple licenses are needed for the distribution of software to campuses, a group purchase and a single point of contact provide considerable discount.

All proprietary software is acquired in the name of the Trustees of the CSU employing a single point of contact in the central office. Each piece of software is tested, debugged, provided with on-line documentation and user friendly access procedures and then distributed to the campuses. In this manner it is possible to support a sophisticated library of application software and data bases. It is the aim of the CSU to provide student access to packages and data bases that will be available to them in their future employment or further education. This effort is supported with a staff of 12 people in the central office.

The ingredients which make this support system work include common operating systems on all campuses, networking capabilities, extensive on-line information and problem reporting capabilities, a cohesive group of academic computing coordinators and systemwide discipline-oriented faculty groups.

It is an important feature of systemwide procurement that the computers have compatible operating systems, programming languages, internal and external character sets, print-lines, etc., throughout the CSU. These requirements also meet minimum configurations for processing systemwide administrative systems and are satisfied in conjunction with upward compatibility characteristics of the upgrade configurations. These system requirements are meant to minimize personnel costs for the maintenance of operating systems and the development of administrative applications, but they also well serve the needs of supporting a library of instructional applications software and databases.

The computers are linked in a redundant X.25 data communications network. This enhances the ability of campuses to share software, databases and documentation. It also greatly improves the ability of a small central staff to maintain and update the applications libraries on remote campuses.

The inability of the central staff to do face-to-face consulting with their remote users has necessitated improved use of online aids. These include an online prompted, problem reporting system which is tended on a daily basis. This has reduced the phone calls from frustrated users greatly. An online feedback file of answers to questions received in the problem systems has limited the redundancy in questions. A "help" parameter in all access procedures has further reduced the consultants job. A file called INFO contains a large number of subfiles available for the user to browse. These include revision status reports and comments on languages and packages. Among the most popular INFO files, however, are WHATSON and WHATDOC. The former contains a catalog of the library and the latter provides complete ordering information for documentation available for languages and packages.

In 1975/76 the CSU recognized a need for campus positions to provide consultation to faculty and students on instructional applications, data bases and appropriate software for academic disciplines. Additional needed services were in the areas of documentation, user training and planning for instructional computing. A three-year pilot project on three campuses demonstrated the need for instructional computing coordinators to provide these services. A position was added on six more campuses in 1980/81 and each of the ten remaining campuses received a position in 1981/82. Biannual meetings of this group and the central staff provide an opportunity for sharing experiences and resources among the campuses and have been very successful in developing guidelines for the services these position provide. The experience with the program indicated need for adding lower level instructional computing coordinator positions to extend services to a larger student and faculty community.

Discipline-oriented faculty groups within the CSU have found the shared computer facility a useful tool in their cooperative development of computer based course materials. Some examples of these shared development activities include:

- The political and social science faculty have developed instructional subsets of the ICPSR survey material and on-line teaching modules.
- Business faculty teaching finance courses have developed an extensive system of programs for accessing the COMPUSTAT database.
- Biology faculty on several campuses have found it advantageous to share taxonomy software.
- Faculty in several disciplines have found the maintenance of shared test item data banks and test generating software an efficient and cost effective method of preparing examinations.
- Faculty from several campuses and disciplines are working together to develop mechanisms for providing access to very large data bases such as LANDSAT (topographical) and WEATHER and very large programs such as CAL-ERDA (energy).
- Faculty from several campuses are working together to develop mechanism for sharing expertise and resources in the area of MUSIC-CAI.

The instructional computing resources of the CSU, then, are delivered via a network. This network has both hardware and human components and is hierarchical in configuration. Those things in which there are economies of scale are performed at the hub (or top) while those requiring close interaction with the user are done on-site. People and machines work well in a network of information exchange.

III. DEVELOPMENT NODES

In the Spring of 1984, two systemwide committees were established to help guide the planning for future acquisition and development of computing resources within the system. One of these deals with the administrative areas and the other with the academic. In the summer of 1985, an independent consultant was commissioned to study the efficacy of the central computer center's services. The results of this study were presented to the Academic Computer Planning Committee (ACPC) in March, 1986. From the recommendations in the consultant's report the Academic Computing Enhancement (ACE) Institute was formed with a steering committee appointed by the ACPC to provide direction and oversight.

Several projects are being coordinated under its sponsorship including: The Computation Chemistry project at Fullerton, a computer conferencing project at Sacramento, a supercomputing training project sponsored by San Diego and Sacramento, and the InterUniversity Consortium on Educational Computing (ICEC) project, of which Northridge is a member and which emanates from Carnegie-Mellon University. Each of these projects is based at one (or more) of CSU campuses, and the ACE Institute will help to sponsor participation from the other campuses in each of these projects.

The Institute steering committee gets reports of activities occurring at other campuses and provides information about joint activities. For example, the CAD/CAM project at SLO is open to other campuses and approximately six other campuses are now participating; San Diego State University is a member of the Consortium which supports the San Diego Supercomputer Center and access to the Cray X-MP/48 is available to other campuses through the CSU Network; Fullerton has molecular modeling software with access available to other campuses; and so on.

IV. FUTURE DIRECTIONS

Computer service to the university community in the future will be influenced by advances in the technology. The five areas of technology most likely to have an impact are advances in telecommunications, supercomputers, high performance workstations, artificial intelligence and intelligent tutoring systems. These are likely to influence the CSU in the continuation and further development of current projects as well as the commencement of new ones.

Development node activities under the ACE Institute are already having an impact on plans for the future. The advanced workstation project which resulted from membership in the ICEC has already been expanded to a second campus for further explorations, development, and application. It has also influenced the specifications for advanced graphics workstations in the current budget formulas sent to the state for funding.

The computational chemistry project gives students and faculty in chemistry access to sophisticated tools for molecular design and study, remotely, and can be made available on local computers.

As the need for supercomputer access increases, most universities will probably find the need to decrease its remoteness. A system the size of the CSU will likely find a place in its network to house such a computer.

Library catalogs and services will likely find their place within the computer network. Online public access to library catalogs already exists on some campuses.

The increased complexity of available resources within computer networks will tend to swamp the skills of user services staff at the central node. This, however, will tend to be mitigated by advances in technology in two areas. First of these is the increased functionality of the telecommunications networks. This will allow the distribution of expert assistance throughout the nodes of the network. Electronic mail, conferencing and bulletin board features already assist remote users. Users will become unaware of which remote (or local) site is providing them service. While the technology appears to be sound, the governing structure of such a service function may, indeed, be extremely complex.

A second technology which will assist in serving users involves the application of artificial intelligence to some areas of service. Intelligent tutorials will provide online assistance to the users of the various resources available. User modelling should provide individualized user environments. Intelligent system interfaces may eventually provide the user with a system whose individual computers and software are transparent to the user. The delivery of user services in a multicampus network will surely undergo some exciting changes in the not too distant future.

ARIES
AUTOMATED MATCHING OF PEOPLE, RESOURCES AND OPPORTUNITIES

presented by

Katy Neff - Data Base Analyst, Computing Services

Tom Martinson - Associate Director, Office of Research

Ball State University

CAUSE 86

ABSTRACT

ARIES (Academic Resource Information Exchange System) is a campus information network developed at Ball State University to assist faculty in locating resources such as research grants, educational films and videotapes, periodicals, and individuals with expertise in specific areas. ARIES consists of resource databases which are available for on-line search, plus a matching facility that generates personal notices informing each individual of the grants, films and periodicals which relate to the person's specific interests.

Ball State University is located in Muncie, Indiana, a community known among sociologists as "Middletown" from a study by that name done in 1929 by Robert and Helen Lynd. Ball State, like Middletown, can be characterized as "representative" in terms of size and resources, with an FTE enrollment of about 17,000 students and 3,000 employees of whom 1,100 are faculty. In an institution of this size the faculty and staff do not all know each other, and many are at best vaguely aware of resources and opportunities available on campus. The ARIES system utilizes the University's central computing system and communications network to bring these people, resources and opportunities together.

Specifically, ARIES consists of four databases — 1) faculty and staff profiles, 2) grant opportunities, 3) films and videotapes, and 4) the library's periodicals. These databases are available for on-line search from any of the 1,200+ devices connected to the VAX network, in addition to dialup access from off-campus locations.

ON-LINE SEARCH

The ARIES search is menu-driven and extremely simple to use. The first screen of the search is a menu of databases. When a database is selected, the computer displays a list of search options for that database, such as keyword, text string, etc. When a search option is selected, the computer explains the expected input to initiate the search, such as a keyword. The search returns a list of "hits", from which the user can select a line number to display more information about the person or item.

The ARIES system includes on-line help information explaining the contents of the databases, search options, recent changes, sources of the information and "commercial messages" from the Office of Research and the library.

The search program maintains usage counts and a search log to provide feedback to the Office of Research, Educational Resources, Library Periodicals and Computing Services. The search log includes a record of every search (user's name and department and the search parameter such as keyword or text string). This log provides the Office of Research and the library with information about the types of materials people are looking for, and the overall utilization of the system.

THE AUTOMATED MATCH

Automated match programs are run periodically by the offices responsible for the databases. The match process relates keywords designating the interests of the faculty to keywords indicating the subject matter of the resources. This process generates personalized notices to inform each individual of research grants, films or periodicals relevant to his/her specific interests. An innovative feature of ARIES is a link with the VAX electronic mail system. Individuals who frequently use EMAIL can elect to receive their notices electronically. At this point in time, the majority of the notices are printed, however as more terminals are installed in faculty offices we expect to see an increase in the EMAIL mode of distribution.

The ARIES system has been evolving in a piecemeal fashion, and new features can often be attributed to serendipity as much as planning. The idea for the EMAIL connection came about during the sub-zero January days when the authors began to utilize the EMAIL facility as an alternative to the cross-campus trek for project meetings. It occurred to us that an EMAIL interface would be an efficient means of distributing database information to the faculty. EMAIL distribution saves printing and envelope-stuffing time; consequently the faculty receive their notices about two or three days earlier through EMAIL, with considerably less secretarial effort.

The four databases in the ARIES system are described here in the order in which they were developed. The heart of the system is the faculty and staff database, which was the first to be implemented during the 1984-85 academic year.

FACULTY PROFILES

The idea for the faculty database was first suggested by the Office of Research. This office receives information about grant opportunities from the Office of Federal Programs in Washington, then forwards this information to the individuals most likely to be interested in particular grants. This notification was being done in a haphazard manner, by searching the mental databases of the staff who had become familiar with the faculty's research interests in the course of their work with grant proposals. There were two difficulties with this procedure — 1) information was not reaching all of the faculty, especially those recently hired, and 2) staff turnover resulted in the loss of the knowledge of faculty interests.

The Office of Research began exploring alternative methods for identifying research interests of the faculty. At the same time, the Center for Entrepreneurial Resources and Applied Research, serving as a liaison between the business community and the University, expressed a need for a database of faculty expertise to identify individuals interested in consulting opportunities. The Office of Research, CERAR and University Computing Services combined efforts to implement the faculty and staff database.

In the analysis of this situation, our first thought was to make use of the computerized human resources system on the IBM mainframe. Curiously, "human resources" systems are not necessarily designed for storing and retrieving information about human resources (i.e. knowledge and expertise); these systems tend to deal exclusively with payroll and employment status information. Since there was very little helpful information in those files, we proceeded to build a new database. Our decision to use the VAX rather than the IBM was based primarily on ease of access by the Office of Research, CERAR and the faculty. The new database was christened "Eureka", and is still known by that name. ("ARIES", a name invented later, refers to the entire collection of databases).

Information in the faculty and staff database comes from a questionnaire distributed by the Office of Research. In its current form, the questionnaire consists of three parts. The first part contains a few general questions, such as name, rank or title, department and college affiliation, foreign language proficiency, and licenses or certificates. The second part asks for keywords identifying the person's professional interests and expertise, and countries of international experience. The third part is a free-form "thumbnail sketch" describing the individual's research activities, consulting experiences, grants, publications, etc.

The thesaurus of keywords used in this database was obtained from the University of Texas at Dallas. Its development was funded by an NSF grant; the thesaurus is now in the public domain and is used extensively throughout the federal establishment to identify programs.

The thesaurus consists of about 1,500 keywords arranged in a three level hierarchy (main category, topic and subtopic). Each keyword is assigned a seven-digit number; the first two digits indicate the main category, the next two represent the topic and the last three digits indicate the subtopic. This hierarchic arrangement is especially suitable for a menu-driven search, and the numbering scheme provides a means of representing a keyword with only seven characters, which saves considerable disk space.

The faculty and staff database has several on-line search options — name, department, keyword, text string, language, and country of international experience.

When a search option is selected on the menu, the computer asks for the search key (name, department, etc), then returns a list of "hits". The user can then select a line number from the list to display the database information. Most of the search options return a "hit" list almost instantaneously, except for the text string search which takes a minute or longer to scan the entire database (depending on the system load).

Participation on the part of the faculty is entirely voluntary but strongly encouraged by the administration. During the first year, approximately 200 faculty returned questionnaires, and around 350 the second year. This year we have revised and simplified the questionnaire and hope for wider participation. With the addition of the films and periodicals databases, we hope to attract those faculty whose interests are primarily in teaching, as well as those active in research and consulting.

GRANTS

During the second year of the project (1985), the Office of Research developed a database of grant opportunites. This database contains grant information obtained from the Office of Federal Programs in Washington D.C.; it includes the agency name, deadline, a brief description of the grant and the contact name and address. The Office of Research adds keywords to each entry. This text is currently prepared on a micrcomputer and uploaded to the VAX, then merged into the grants database. This process is done monthly. To expedite this procedure, the Office of Research is currently experimenting with direct download of the information from Washington through PACNET (Stanford University).

On-line search options for the grants database include month, keyword and text string. The automated match between faculty and grants is run monthly.

EXPANSION OF THE SYSTEM

With the successful implementation of these two databases and the automated match between faculty and grants, it became apparent that this technique for information dispersal could be more widely applied to academic resources of interest to the faculty. At this point the scope of the project was expanded, and the name "ARIES" adopted for a growing collection of integrated databases.

FILMS AND VIDEOTAPES

The films database was created initially on an Apple (using PFS:File) by the Educational Resources center in Library Services. By the time the decision was made to incorporate this information into ARIES, the films database had grown to 5,000 records on 25 floppy disks. The upload to the VAX required four steps to convert each disk to ASCII (using a bridge program), then to a format that could be uploaded. After the transfer the data then had to be loaded into the VAX database with a special conversion program, and edited (a time-consuming effort!).

Another obstacle to overcome was the classification by keyword, which is necessary to match films with faculty. The Educational Resources department classifies films by "educational film locator" subject headings. A translation table was set up to map these subject headings to ARIES keywords, so that films can be located by either classification scheme and matched with faculty interests on the ARIES keywords.

The films database can be searched on-line by title, subject (educational film locator), keyword (ARIES keywords), and text string. Information on each film includes title, length in minutes, format, color, sound, year made, vendor and up to 10 lines of annotation in addition to subject and keyword classifications. Lists of rental films, previews and recent acquisitions are also available on-line.

PERIODICALS

The periodicals database has a similar history. It began life as a dBase file on a PC. Following a series of hard disk failures, the database was moved to floppies (46 in all), and then transported to the VAX. Due to the ease with which dBase can be translated to ASCII, this conversion went very smoothly and was completed within a few days.

At this time the periodicals database is used to print hardcopy listings which are bound and distributed to various academic departments. The database is currently undergoing revisions to add additional information (department fund code and keywords). When these revisions are complete, the periodicals database will be searchable on-line by title, keyword and department fund code.

In addition to the on-line search by the faculty, another significant use of this information is to provide listings of these resources for academic departments in support of curricular program reviews for accreditation.

SUMMARY

The ARIES system is an example of the trend addressed by the theme of this conference, "converging technologies". By combining database retrieval, automated keyword matching and electronic mail, ARIES utilizes the University's mainframe computing facilities and communications network to assist faculty in locating research grant opportunities, films and videos for classroom use, the library's periodicals, and other faculty with common interests or expertise in specific areas. By matching people and resources on common keywords, ARIES turns the "impersonal" computer into a very personal information retrieval system.

VENDOR PARTICIPATION

Twenty-two vendors with computer-related products and services participated in the CAUSE National Conference, as listed on the next page. The vendor presentations, sponsorships of conference activities, company hospitality, and suite exhibits offered by these companies contributed a great deal to the success of the conference and its value to conferees.

Coordinator:
Joseph Catrambone
Loyola University of Chicago

Scott Porter
Racal-Vadic, Inc.

Ken Rodgers
Arthur D. Little

Chuck Thomas
Information Associates

Eric Zarakov
Apple Computer, Inc.

PARTICIPATING VENDORS

The following companies participated in and contributed to the success of CAUSE86:

American Management Systems, Inc. (AMS)
Apple Computer, Inc.
Arthur D. Little, Inc.
AT&T Conversant Systems
Business Information Technology, Inc. (BIT)
Business Systems Resources, Inc. (BSR)
Cincom Systems, Inc.
Compression Labs, Inc. (CLI)
Control Data Corporation (CDC)
Coopers & Lybrand
Cray Research, Inc.
Cullinet Software, Inc.
Datatel Minicomputer Company
Digital Equipment Corporation
Ernst & Whinney
IBM Corporation
Information Associates (IA)
Integral Systems, Inc. (ISI)
Peat Marwick
Prime Computer, Inc.
Racal-Vadic
Systems & Computer Technology Corporation (SCT)

American Management Systems, Inc.

Taking Advantage of Today's Computer and Communications Technology without Losing Your Shirt

Abstract of presentation for CAUSE86

Winder G. Keating
Vice President
American Management Systems, Inc.

Colleges and universities face an increasingly complex world as they attempt to put in place the computing and communications they need to support academic and administrative computing operations. Whether the objective is to build a sophisticated "networked campus" in an effort to lure students and faculty or simply to take advantage of increased power and lower costs, the options (technologies, products, vendors, etc.) are many and the consequences of the wrong choice can be disastrous.

Topics in this session included:

- identifying the opportunities for using data processing, office automation, and communications on campus, and the specific capabilities needed;
- developing a realistic, affordable plan for meeting these needs; and
- successfully acquiring, implementing, and managing the systems.

The presentation was intended for those who are responsible for planning and managing the information systems of a campus and for those who make investment decisions for major technology acquisitions.

Representatives of AMS were also available in the AMS suite exhibit to discuss the firm's two software products for administrative computing in higher education, CUFS (College and University Financial System), a fully integrated financial management system which runs on IBM mainframes and the DEC VAX, and DIS (Development Information System), an integrated institutional advancement support system composed of alumni records, gift processing, and fundraising subsystems.

Desktop Publishing in Higher Education

There is a new buzz word in personal computing these days. Its called Desktop Publishing. As with any hot topic in personal computers, this new term generates a lot of attention. It also generates new questions. What is Desktop Publishing? How does it effect Higher Education? What is Apple's role?

Apple Desktop Publishing is really the convergence of three different technologies:

1. The Macintosh personal computer - a powerful high resolution printer that treats text and graphics as equals.
2. Very powerful and easy to use third party software that allows you to control the creation, editing and placement of text and graphics.
3. The Apple LaserWriter printer - a low cost near-typeset quality printer.

How does this impact higher education institutions? Colleges and universities can benefit from Desktop Publishing more than most other markets. In fact they have the potential for being one of the biggest users of these new technologies.

As large institutions, they need to perform the same kind of printing that any large organization needs to do. These basic office printing needs consists of: memos, letters, flyers and management reports. Each college or university has dozens of administrators, hundreds of faculty and thousands of students. All of whom need to communicate to each other and the outside world.

In addition to these traditional office printing needs, schools have a completely different set of printing and publishing needs. The very nature of higher education is to write books, papers, grants, manuscripts, reports, thesis, exams and other documents to communicate ideas. Services are promoted to the community. Funds are solicited from foundations, alumni and government. Dissertations, books and newsletters are published. Publish or perish is a part of life in higher education. Higher education depends on print.

The ideal desktop publishing system has all of the following features :

1. Easy to use.
2. Allows text and graphics to be merged on both the screen and the printed page.
3. Based on a powerful personal computer with a large third party software base.

Apple's Desktop Publishing system is particularly well suited for Higher Education.

Educators are busy. Planning courses, running a department and meeting with students and faculty takes time. Time that they can not afford to spend on learning a complicated

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, California 95014
408 996-1010
TLX 171-576

computer system. Since its inception, the Macintosh was designed to be easy to use and easy to set-up. A uniform user interface on most Macintosh applications allows an educator to quickly learn a wide variety of new applications.

Text and graphics are treated as equals on both the Macintosh screen and the LaserWriter printer. The LaserWriter uses the Postscript page description language by Adobe Systems Inc. Postscript allows the LaserWriter to print documents containing text and detailed graphics. Special fonts are often needed in higher education. There are a variety of third party developers who provide mathematical, chemistry, Greek and Russian fonts. A large selection of type faces are also provided by Adobe Systems, Inc.

One of the strongest components of the Apple Desktop Publishing system is the wide variety of third party software products that are available. Over 1500 software packages allow a user to create memos, letters, free form graphics, statistical charts, graphs, forms, mathematical equations and other materials that are particular to higher education.

The Apple Desktop Publishing system is changing the way information is generated and used in academia. Individuals can now generate both simple and complex documents in their office. Grant proposals, exams and reports can leave an educators office in its final form. A form that contains a higher degree integrity and professionalism that was not previously possible.

STRATEGIC PLANNING FOR INFORMATION TECHNOLOGIES IN HIGHER EDUCATION

by
Dr. Kenneth W. Rodgers
Supervisory Staff Associate
Information Systems Section
Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts 02140
617-864-5770

This presentation reviews the current practice and projected trends for strategic planning for information technologies in higher education. The Arthur D. Little, Inc., staff have adapted Michael Porter's competitive analysis and strategy framework for planning information technologies in higher education. We have developed our own approach to Strategic Value Analysis based upon the data base design work by Robert Curtice and Paul Jones. The goal of strategic planning is to assist senior executives and their advisors to better understand the impact of information and its supporting technologies on the strategic goals of the institution. This approach provides a framework for defining the external forces and internal dynamics of your institution which affect the use of information and information technologies.

What's really happening to our institutions can be summarized in one word -- change. Change is occurring in the expectations for contributions for the institution -- both from "buyers of our services" and from suppliers. Planning for information technologies needs to focus more on supporting the mission of the institution -- including the primary missions of instruction, research, and public service, and the supporting missions of academic, student, and institutional support. The role and function of support services are changing, for such areas as the library, business operations, and the medical center for those institutions with a Medical Center. Our strategic planning focus is also on change in information technologies -- the hardware, software, and communications technologies. The costs of computer power and data storage are decreasing, and are projected to continue to do so in the next ten years. These falling costs, along with other breakthroughs, offer institutions opportunities to exploit the benefits of information technologies for their own strategic advantage. Technology can help achieve institutional goals. Perhaps more importantly, if not properly used, can put your institution at a disadvantage competitively. The work of Arthur D. Little focuses in three broad areas as discussed below.

STRATEGIC VALUE ANALYSIS

Strategic Value Analysis (SVA) is a comprehensive methodology developed by Bob Curtice and other information technology professionals at Arthur D. Little, Inc., that helps an organization analyze and develop a plan for exploiting the strategic benefits for using information technologies. The methodology includes the following:

- An understanding of the institution's educational mission and objectives;

- An analysis of functional activities and data flows;
- An identification of information technology opportunities for each activity;
- The relationship of the value of each opportunity directly to the institution's mission and objectives;
- A definition of an integrated systems and data architecture to benefit from those opportunities; and
- An implementation plan that specifies projects, schedules, resource requirements, costs and benefits.

SVA benefits are derived as much from the process of applying the methodology. SVA is supported by IRMA -- a computer-based software tool developed by Arthur D. Little that helps integrate the planning and design of information systems with the institution's overall objectives. (Robert M. Curtice, Strategic Value Analysis: A Modern Approach to Systems and Data Planning, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1987)

LOGICAL DATA BASE DESIGN

Curtice and Jones have developed an approach to logical database design that emphasizes the need for the database to reflect the conditions that exist in the "real world" that are of interest to the institution. Examples of these conditions are the type of student body selected, the curriculum, the research conducted, and the services offered to the public. Databases that reflect these conditions should have flexibility, clarity, efficiency, and semantic integrity (Robert M. Curtice and Paul Jones, Logical Data Base Design, New York: Van Nostrand Reihold Data Processing Series, 1982). This methodology has been used in several organizational settings. The IRMA design tool is available to facilitate its use. A seminar is offered semi-annually on SVA, logical data base design, and an overview of the IRMA tool.

COMPETITIVE PROCUREMENT OF INFORMATION TECHNOLOGIES

The strategic planning approach utilized by Arthur D. Little contributes to selecting and procuring information systems, hardware, and communications systems. This approach has been utilized in the selection of the major types of application systems of interest to CAUSE membership, including:

- Student Records and Information Systems;
- Financial Information Systems;
- Human Resource Systems;
- Library Automation and Scientific and Technical Information Systems;
- Facilities Management and Auxiliary Services Systems;
- Hospital Information Systems;
- Office automation systems;
- System software, data base management systems, and computing hardware; and
- Telecommunications systems.

If properly planned, your institution can have a real choice among currently available options. If you would like assistance in the above areas, please contact me at the above address.

AT&T

Conversant Systems

6200 East Broad Street
Columbus, Ohio 43213
614 860-2000
Cornet No. 8-353-2000

AT&T's Conversant Systems participated in the Cause Conference by having a Hospitality Suite and Exhibit. The relaxed atmosphere of the suite enabled the attendees to not only enjoy themselves and try some very tempting gourmet treats, but also to learn more about the CONVERSANT* 1 Voice System. Ms. Bonnie Smith and Mr. Peter McParlin, from Conversant Systems, circulated among the attendees to answer questions and give demonstrations of the system.

The CONVERSANT 1 Voice System is a voice response/voice recognition system that can be utilized in many ways on a college campus to increase productivity, provide better service, reduce costly errors, and make more efficient use of staff resources.

One of the best applications for the product is the automation of enrollment and registration procedures. Conversant Systems is currently installing a 64 line system for college registration. A student can call to register any time of the day or night as long as she/he has access to a Touch-Tone phone. The benefits for a student using a voice response system are numerous For example, the student does not have to go to the campus and stand in long registration lines. She/he can call from the convenience of the home or dorm room. The caller's access time may be 2 minutes or less to register for a full semester of courses.

The CONVERSANT 1 Voice System can run multiple applications concurrently. Therefore, a system may be configured to also allow a student to add or drop courses, query about courses, reserve dorm rooms, and pay his college fees. It may allow him to hear about student activities or emergency school bulletins; or a student applying to the college may be able to find out his admission status or information about the financial aid programs that the college has to offer.

Because a system can allow access to various applications through identification numbers, a staff member might have access to certain applications to which students may be denied access. Examples of applications that a staff member might access are: entering grades for his students, posting staff or departmental announcements, reporting time for payroll purposes or possibly managing and controlling inventory.

The CONVERSANT 1 Voice System can provide security through the use of a student or faculty identification number as well as a personal identification number.

---

* Registered Trademark of AT&T

A variety of telephone network interfaces provides great flexibility in meeting the individual telecommunication needs of each institution.

The system can be configured to handle from 4 to 32 simultaneous calls. The basic system offers Touch-Tone input and voice output. Features such as attendant transfer, voice recognition, as well as the ability to put timely messages on the system or allow a caller to leave a voice message during a transaction are available as options.

For further information about the CONVERSANT 1 Voice System and how it may benefit your college, or to hear a demonstration of the system, you may call Ms. Smith at 1-800-341-2272.

Business
Information Technology, Inc.
A Professional Corporation
P.O. BOX 4569 • WILMINGTON, DELAWARE 19807 • 302-656-3606

COMPANY PROFILE

Business Information Technology provides consulting services for companies seeking enhanced use of computer technology. The firm supplies a full range of consulting services for business system applications to commercial, manufacturing/industrial, educational, banking, medical, governmental and institutional clients. The firm specializes in:

☐ **Human Resource Systems** — Payroll, Personnel, Position Control and Budgeting, Applicant Tracking, Compensation Planning, Skills Inventory, Job Progression Analysis, Affirmative Action Planning and Reporting, Benefits Planning and Projections.

☐ **Financial Systems** — Accounts Payable, Accounts Receivable, General Ledger, Product and Job Costing, Financial Planning and Budgeting.

With an office on each coast, the firm provides services to national clients including Fortune 500 companies and large non-commercial clients. The company was founded by a group of highly qualified professionals dedicated to improving the effectiveness of business systems. The range of experience and specialized talents of the firm's consultants is demonstrated by the satisfaction of the clients they serve. Their experience in commercial purchased packages includes dozens of installations; also, as designers of packaged software they are especially qualified in the evaluation and selection of packages best suited to a client's needs. They understand the functional areas as well as the technical requirements.

The firm does not market packages, but instead specializes in the installation of packages purchased by clients. Generally, clients utilize our consultants in the following areas:

- **Requirements Definition and Market Surveys**
- **Selection and Evaluation of Vendor Packages**
- **Implementation Project Planning (using unique proven approaches)**
- **Package Adaptation and Analysis (including specifications and programming)**
- **Training Program Development and Implementation (at all levels)**
- **Documentation and Procedure Development**
- **Specialized Technical Support**
- **Project Management Skills**

The firm will provide support to clients according to a negotiated service plan based on the specific requirements of the client.

The firm can be contacted at either of two locations:

Mr. John B. Maitland
Senior Vice President
(415) 671-0595

P.O. Box 83
Concord, California 94522

Mr. Paul J. Piper
President
(302) 656-3606

P.O. Box 4569
Wilmington, Delaware 19807

BUSINESS SYSTEMS RESOURCES, INC.

BSR's suite exhibit at CAUSE86 featured Advance, the most comprehensive system available today for institutional advancement. Advance is designed to support the needs of the largest and most demanding development organizations. On-line features include maintenance and inquiry of extensive biographical data and relationships, entry of pledges and gifts, full giving history, and support of major prospect tracking and campaign management functions. Interfaces with accounting systems and word processing are supported. Exceptionally easy to use, Advance features a menu structure for selecting functions, a powerful name lookup function for persons and corporations, and powerful query facilities for ad hoc reporting. Advance versions are available for both IBM mainframe and Digital VAX computers.

Cincom Systems, Inc.

Doug White, Data Base Industry Consultant for Cincom Systems, Inc., discussed the changing architectures of data base management systems in a vendor presentation entitled "The Changing Architectures of DBMS." His focus was on the emergence of a relational three-schema architecture and its importance to the data processing industry.

This presentation was closely related to the Cincom suite exhibit featuring the firm's data base/data communications and applications software. Cincom develops and markets an integrated architecture of software for IBM, DEC, NCR, and Wang computers (among others), which includes relational data management, application development tools, business control applications, decision support systems, and network management.

Compression Labs, Inc.

In a vendor presentation at CAUSE86, entitled "Videoconferencing," Eric Sternberg, Manager of Market Development for Compression Labs, Inc., examined higher education success stories in videoconferencing and indicated how this technology can have an impact on the bottom line. He outlined what videoconferencing is, where it's going, who uses it and why, and technical considerations in the implementation process.

Compression Labs, Inc. (CLI) manufactures videoconferencing equipment that makes interactive video communication a practical, cost-effective management tool. Some of their desktop videoconferencing equipment was on display in their conference suite, and a short tape on CLI's REMBRANDT® video system was available for conferees.

CONTROL DATA

Eden: The Total Solution

Control Data offers institutions a *complete* solution for their administrative data processing needs through its Eden system of administrative applications. The Eden System is composed of:

- The Student Records System;
- The College and University Financial System;
- The Human Resource System.

Eden offers a unique solution to your college's or university's needs that cannot be provided by any other hardware, software, or services vendor; a single source supporting a comprehensive package of tools to meet your campus' needs. The package includes sophisticated, proven, and integrated software backed by powerful computers and a knowledgeable and responsive support staff. Through these offerings, Control Data ensures that your campus' administrative needs will be addressed more efficiently and effectively than has been possible before.

Designed by Administrators, for Effective Administration

The Eden software is a comprehensive package of applications designed to meet the diversity and range of administrative system needs on college and university campuses. Eden was designed by experienced professionals; professionals who have faced many of the challenges you and your staff deal with on a daily basis.

Independent, Yet Integrated

Each of the Eden Systems operate independently or, if desired, as an integrated partnership. The three systems have been designed and enhanced to maximize the availability and accessibility of your institutions' data and to do so in concert with your unique institutional policies. The Eden Systems not only talk to one another, but they listen as well.

Flexible

Each of the Eden applications is flexible to insure that, not only does the software meet your campus' current needs, but can also adapt to the changing policies and procedures of tomorrow.

Performance Driven Hardware and Software

The Eden Systems effectively utilize the family of operating systems and data base management software available on the CYBER family of computers.

Single Vendor Solution

Perhaps most importantly, the Eden Systems are a Control Data product. Your campus' hardware, software and maintenance support are all provided by a single vendor. This consolidated delivery program ensures that your institution will achieve the highest degree of reliability with minimal intervention from campus staff.

Control Data also offers to institutions solutions for computer based education, Plato, office automation, Officeware, and a superior data base management system, IM/DM. For more information about the Eden Systems - or for answers to your questions about other Control Data higher education products - contact your nearest Control Data sales office.

Eden: Comprehensive Administrative Software to Support the Campus Management Team

Coopers & Lybrand

Abstract of a presentation for CAUSE86 by

Glenn Rosenberg
Manager, Coopers & Lybrand

The strategic planning process helps a college to assess the role technology plays in carrying out its mission and to determine the level of investment which is compatible with its traditions and values. Some institutions are more aggressive than others in the use of technology in their curriculum and administration; others are more evolutionary in their approach. In all cases, the direction taken should be comfortable given the strategic mission of the institution.

Coopers & Lybrand's higher education systems' consultants have assisted numerous colleges across the country to plan for technology, and have identified the steps which are necessary to implement an on-going planning process. This session reviewed the firm's methodology for strategic systems planning and explored how that methodology has been tailored to meet the expectations of colleges and universities of many sizes.

Cray Research

Supercomputers in the University Environment

Summary of a presentation given at CAUSE86 by

W. Derek Robb
Director
University Marketing

Supercomputers are playing a significant new role in academic research on university campuses across the world.

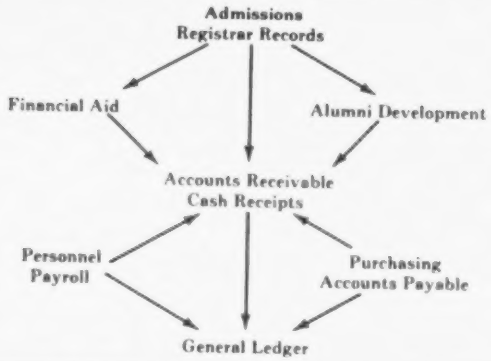
This presentation described the many possibilities for using CRAY computers in existing academic computer environments, with particular attention to networks, operation systems, and applications software.

CULLINET SOFTWARE, INC.

CAUSE86 conferees were invited to Cullinet's suite to learn how Cullinet software can help in the development and maintenance of responsive information systems.

Cullinet's data management, applications, and information center software has been chosen by many leading higher education institutions and software service vendors as the technology of choice.

Datatel Datatel Inc. ☐ 3700 Mt. Vernon Avenue ☐ Alexandria, Virginia 22305 ☐ (703) 549-4300



COLLEAGUE

College and University Information System

COLLEAGUE,* is a comprehensive minicomputer based system for managing the information processing in all administrative areas of an educational institution. It was developed by Datatel Minicomputer Company (DMC), an experienced software design firm, to meet the needs of higher education. COLLEAGUE operates on Prime computer hardware which is also capable of providing a broad range of computer languages for use by college/university academic staff. The system can be upgraded as your needs grow. COLLEAGUE, the software element of the system, is designed for flexibility to meet the unique requirements of any campus. It is enhanced on a regular basis by DMC to serve the growing needs of administrative offices. The system is comprised of a variety of modules including:

Accounts Payable

The Accounts Payable module of COLLEAGUE controls the disbursement of funds from purchase orders, other invoices and accounts receivable refunds. Checks are printed automatically from one or more bank accounts. Information previously entered on a purchase order does not have to be re-entered. Receivable accounts are automatically charged if appropriate. Check reversal is a simple one-step process with reversing general ledger entries posted automatically. Check reconciliation requires little effort and is designed to expedite the process of confirming bank statements.

Accounts Receivable

The Accounts Receivable module of COLLEAGUE tracks student receivables as well as any subsidiary ledgers which balance back to general ledger control accounts. The Accounts Receivable module has access to all student registration records. Student billing and any later adjustments resulting from added or dropped courses are processed automatically. Designated financial aid and cash receipts are credited to accounts receivable and this information is transmitted to general ledger. All necessary reports, such as aged and detail trial balances, invoices and statements can be printed on demand.

Admissions

The Admissions module of COLLEAGUE provides a dynamic marketing tool for recruitment and analysis of all potential students. Information is gathered from inquiries, tape services or other sources and is used without repetition of data through prospect, applicant and student classifications. Comprehensive profiles can be created combining statistical reports, secondary school or college records and testing results for comparing prospective students. In combination with word processing, this data can be used to produce personalized letters using a fraction of the manpower previously required.

Alumni/Development

The Alumni/Development module of COLLEAGUE provides the tools necessary for effective generation and tracking of pledges and gifts. Using the extensive data base, specific individuals or corporations can be targeted for intensive cultivation. Giving history is immediately available for examination and planning of future funding drives. Donations are available for automatic transmittal to business office files through the Cash Receipts module. Word processing capabilities allow personalized solicitation and acknowledgement letters to be printed, indistinguishable from those typed by hand.

Cash Receipts

The Cash Receipts module of COLLEAGUE provides a complete system for tracking incoming funds. Receivable accounts are automatically credited, donation receipts are captured from information previously entered by the Alumni/Development office and receipts from auxiliary services are recorded to the appropriate accounts. General ledger accounts are automatically updated after transactions are verified with an easy, one-step process.

Financial Aid

The Financial Aid module of COLLEAGUE produces comprehensive information to facilitate distribution of financial aid. It helps maximize available funds in the recruiting process. Precise knowledge of outstanding offers, acceptances and refusals help the development of realistic proposals based on current financial information. The system also accepts data from financial services via magnetic tapes, allows automatic update to accounts receivable and provides statistics required for government reporting.

Fixed Assets

The Fixed Assets module of COLLEAGUE records capitalized assets and tracks selected noncapitalized equipment. Original cost, current value, salvage value and amount spent on renewals are stored with descriptive information for each asset. Capitalization, use allowance or depreciation and disposal entries are automatically posted to the general ledger. Separate reports are printed for property and equipment.

General Ledger

The General Ledger module of COLLEAGUE is the cornerstone of financial transactions within the system. The account structure is highly flexible and follows NACUBO recommendations. Most financial transactions are initiated through other modules and after automatic posting, are controlled and consolidated twice. In addition to standard reports, the General Ledger module offers a financial statement processor, allowing user-designed financial reports.

Inventory

The Inventory module of COLLEAGUE provides complete control over all items in each school's stores. Supplies for work orders or for departments are distributed through stock issues. The inventory records contain complete descriptions, quantities on hand, quantities committed, as well as quantities on order. This information is updated directly from purchasing. Costs are distributed to departments as incurred and are posted automatically to the general ledger. Inventory evaluations can be calculated on demand. The system facilitates physical inventory by providing easy-to-use worksheets and streamlined data entry screens.

Payroll

The Payroll module of COLLEAGUE provides a secure, accurate system for performing standard payroll functions with special features unique to Colleges and Universities. Earnings limits are monitored, a percentage of college work study salaries may be distributed to other expense accounts and receivable accounts may be credited automatically from payroll deductions. Issuing a replacement check is a simple, one-step process. Fiscal year as well as calendar year histories are maintained and annuity deduction information is readily available.

Personnel

The Personnel module of COLLEAGUE allows tracking of job applicants and current employees. It maintains biographical and employment information on job applicants and all personnel of the institution. The module stores skills, promotion records, salary history, contracts and benefits coverage and other information. Vacation and sick leave hours are accrued and use is automatically updated from the Payroll module. Systematic coding provides you with helpful information for generating EEO reports.

Physical Plant

The Physical Plant module of COLLEAGUE processes work orders from request to completion. A description of the task, the account to be charged, trade classifications required, cost estimates and job priorities are entered. Status reports can be obtained at any time. Material usage is automatically updated from purchasing and inventory. Employees of the institution, verified against the Personnel module, and outside contractors with their billing rates and hours worked, are entered to calculate labor costs. Completed work orders are charged to departments and automatically posted to the general ledger.

Purchasing

The Purchasing module of COLLEAGUE controls the ordering and receiving of goods and services. Vendor history is maintained, purchase order forms are printed by the computer, encumbrances are posted to general ledger accounts and receipts and invoicing of goods are recorded for automatic transferral of information to accounts payable.

Student Affairs/Housing

The Student Affairs/Housing module of COLLEAGUE is both a valuable source of information about students and a tool to help perform the primary tasks of the Student Affairs and Housing offices. The module provides housing assignment, miscellaneous charge generation and social organization membership maintenance. Administrators can quickly assign housing, locate students and institute miscellaneous charges which are added to the student's accounts receivable.

Registrar/Records

The Registrar/Records module of COLLEAGUE greatly simplifies the tasks of registering students for classes, tracking transcript information and keeping student records current. Registration records are immediately available to the Accounts Receivable module for customized billing including add/drop billing. Transcript records can be separated to accommodate different grading systems within your institution; and anonymous grading, unique to law schools, is easily accomplished. After graduation, student records are automatically transferred to the Alumni/Development module without re-entry of data.

Word Processing

The word processing capabilities of the COLLEAGUE system provide data integration with the administrative software. Word processing allows easy access to necessary COLLEAGUE files and merges them into any word processing document. This feature offers a wide variety of functions, often far superior to many stand-alone word processors.

The information listed here includes both the base and optional modules of the COLLEAGUE system. Detailed information is available upon request from DMC.

The materials contained herein are summary in nature, subject to change and are for general information only. ©1982 Datatel Minicomputer Company

CPB-82017

Digital Equipment Corporation

The 21st Century Computer Company

CAUSE86 Vendor Presentation given by
Bart Bolton
Manager
Information Systems Marketing

The 21st century is just fourteen years away, and arriving there will be more than a simple drive; it will be a quantum leap. This presentation was a discussion of management, of developing information systems within our organizations to prepare for the future, with the understanding that "management is the making of decisions with incomplete information."

Digital's activities in the world of higher education computing were exemplified in its suite exhibit, a demonstration of network support for Digital's local area network and some third-party software vendors who have implemented solution on Digital hardware. Recently-announced new products were displayed, and BITNET access was available.

Ernst & Whinney

150 South Wacker Drive
Chicago, Illinois 60606

312/368-1800

ON TIME/UNDER BUDGET SYSTEM IMPLEMENTATION

This presentation provided an outline to the planning process for system implementation.

The initial step of this planning process included the actual steps required to plan, supervise and coordinate the implementation planning process. With this planning process is the preparation of the acceptance test which will actually list the conversion and implementation tasks. This step will also include the identification of personnel and other resources required throughout the implementation process.

Included in the planning process is the preparation of user manuals. Upon completion of user manuals is the preparation for user training. Training guides and materials should be established in addition to the necessary data files and data bases necessary to complete user training.

Certain review points should be included to facilitate the quality of the planning process and re-funding, if necessary. Project management review meetings should be held regularly to ensure the quality of the implementation process.

Preparation should include specific system steps and start up procedures. These system tests should at least include tests for job runs, volume and stress, security and controls, facilities, useability and requirements, subsystem test data and subsystem test job controls. Once all preparations have been made for system tests, planning should include time and tasks for the actual system software installation.

Upon the installation of system software, tasks should be identified for the actual system tests. Included in these tasks is training for the system test participants. When system tests are completed, reviews should be conducted identifying needed changes to system programs and documentation.

At this point, the actual system tests should be performed. A standard test package and documentation should be assembled. Upon completion of all acceptance tests, a quality review is provided to evaluate system performance and functionality with user requirements.

Ernst & Whinney provides a full complement of information system consulting services. For more information please contact Jim Coffor at 312/368-1800.

International Business Machines Corporation

10401 Fernwood Road
Bethesda, Maryland 20817
301/897-2000

The IBM Corporation extends its appreciation to the large number of attendees who visited our Vendor Suite. The opportunity to interact and exchange ideas with key higher education executives who have application, planning, implementation, management and evaluation expertise is a highlight of the annual conference.

Two new IBM offerings provided a focal point for interactive discussion. The following is a brief description of these offerings. Additional information may be obtained from the IBM representative for your institution.

IBM PC-Based InfoWindow System

One place many institutions are looking for solutions is in the area of communicating information to students, alumni, faculty and staff in new ways. These institutions recognize the importance of high quality communications in obtaining increased revenue, retention of students, improved competitiveness and productivity.

Using IBM InfoWindow PILOT Authoring and Presentation or Video/Passage Author and Presentor software enables administrators or CAI authors to write a variety of interactive modules for administrative applications or classroom use.

IBM InfoWindow System is one from a family of IBM videotex products that includes Videotex/370, Videotex/370 Service Aid, VTXGRAF, PC/VTXACCESS, PC/Videotex, PC/Colorview, and IBM Information Network.

Education Computing Support System

The Education Computing Support System is an integrated, cost-effective software system that offers a simplified approach to interactive computing for college and university students, faculty and administrators.

This IBM SolutionPac also includes access to an IBM Education Computing Support System Competency Center. This Center will be available to provide installation support and response to questions on usage.

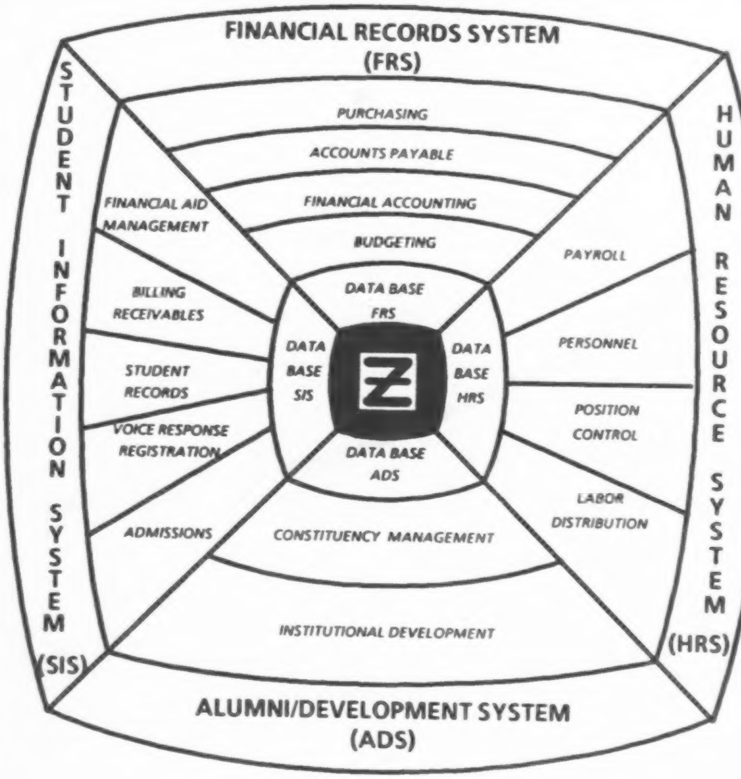
This new software offering contains a variety of advanced academic and administrative features. Supported in the product are Office Support Facility, IBM Personal Computer Support Facility, Program Development and Application Prototyping Facility, Problem Solving Facility, and a CAI component.

Simplified implementation and use, ease of installation together with a reduced skill level support requirement, and easily installed optional products are key benefits this solution offers to the institution.

IBM welcomed the opportunity to introduce these potential solutions for administrative and academic information processing at this conference. The renewal of long standing and the initiation of new partnerships in the higher education environment using the CAUSE conference as a vehicle is a long standing objective for all attendees.

Dr. Robert L. Vogt
Education Specialist
Academic Information System
Bethesda, MD 20817
(301) 564-5618

SERIES Z: GENERAL CHARACTERISTICS AND FEATURES


FINANCIAL RECORDS SYSTEM (FRS)
PURCHASING
ACCOUNTS PAYABLE
FINANCIAL ACCOUNTING
BUDGETING
DATA BASE FRS
STUDENT INFORMATION SYSTEM (SIS)
FINANCIAL AID MANAGEMENT
BILLING RECEIVABLES
STUDENT RECORDS
VOICE RESPONSE REGISTRATION
ADMISSIONS
DATA BASE SIS
Z
HUMAN RESOURCE SYSTEM (HRS)
PAYROLL
PERSONNEL
POSITION CONTROL
LABOR DISTRIBUTION
DATA BASE HRS
DATA BASE ADS
CONSTITUENCY MANAGEMENT
INSTITUTIONAL DEVELOPMENT
ALUMNI/DEVELOPMENT SYSTEM (ADS)

A proven system for today's information management needs.

Series Z is an integrated, on-line software system designed specifically to meet the information management needs of colleges and universities. Incorporating proven concepts from our years of experience with colleges and universities, we've created an affordable system for today's mini and mainframe computers.

Series Z is actually four application systems in one: Financial Records, Human Resources, Student Information, and Alumni Development. All four systems interact with each other. Most of all, however, Series Z provides you with all the information you need to make timely, accurate, intelligent management decisions.

Series Z incorporates an integrated system structure to efficiently handle separate categories of processing, yet address the entire administrative needs of the institution. The Series Z design eliminates data redundancy and promotes efficient processing.

A modular approach to design and integration has been applied. Such design permits 1) phased implementation allowing systems to be added as necessary and within the priorities of the institution, 2) modular sequence flexibility, 3) elimination of data redundancy, 4) a consistent data definition to be maintained as well as system integrity and security, 5) insulation from computing environment changes, and 6) continued development of modules to meet the higher education administration computing needs.

Series Z Data Handler

The Series Z Data Handler controls the storage of data and defines how that data will be integrated. The Data Handler functions as a Data Base Manager for the Series Z administrative programs, integrates with other Data Base Manager Systems or with other non-Series Z application programs. The Data Handler also controls screen formats, and procedures and enables the user to quickly make changes within the system, often without reprogramming.

Security

Series Z has been designed to "police" your information and let you control who sees what. The various levels of security control include: system, application, function or data element or the institution can define special access for limited use. Series Z also defines online changes according to security levels in the same fashion.

On-Line Data Entry, Inquiry and Update

Input to Series Z goes through a single channel, regardless of date, quantity or sequence. This includes both initial data entry and update. All entries can be submitted in online, or in batches. Series Z also provides for on-line inquiry to the data base, at any time.

Screen Generation/ Modification

Series Z permits you to build your own screens, to meet possible user-defined needs not already addressed by the system.

On-Line Help

On-line help features include diagnostic, data definition and screen help. Series Z is designed with such on-line features to assist the user or operator in learning how to use the system faster without the need to consult a manual or leave the terminal.

Software Maintenance

An important aspect of any software purchase is the availability of maintenance. Series Z has a complete maintenance program for regulatory changes and/or enhancements.

Series Z Report Writer

Z Writer efficiently meets the report generation needs of Series Z users. From the simple to the complex, Z Writer is ready to provide the solutions to your ad-hoc reporting and on-demand data needs.

Executive Support System

As colleges and universities begin to treat information as a valuable resource, new systems are required to summarize and present relevant logitudinally consistent information in graphic form to administrators. In keeping with its commitment to colleges and universities, Information Associates is preparing to respond to these needs with a new level of service in the area of planning data base and decision support systems for higher education.

In this session Mr. Thomas outlined the theoretical construct for the Information Associates executive support system development. This exciting new system is founded on an integrated planning data base and networked executive information workstations, driven by the information velocity manager. The session also included an overview of the types of internal and external information that should be available to college and university executives, and the design of the functional modules of the system.

A Leader in Information Services

Our capabilities are backed by a staff of more than 300 professionals who concentrate on every element of each customer's individual requirements.

We are dedicated to seeking better solutions to turn data into useful information. We offer a full range of support services including customer training, user group participation, the necessary documentation, source code, test data, software maintenance and technical support.

Our experience and success in providing flexible, state-of-the-art systems makes us confident that Information Associates has a complete system solution to meet your needs.

So let's get together. One expert to another. Discover the solutions we can bring to help you manage your institution most efficiently. Run with the growing pride of IA.

Headquarters:
3000 Ridge Road East
Rochester, New York 14622
(716) 467-7740
Telex: 6501912647 MCI

Regional Offices:
349 W. Commercial St,
Suite 2800
East Rochester, NY 14445
(716) 385-4664

840 East Central Parkway
Suite 150
Plano, TX 75074
(214) 578-1007

11150 Sunset Hills Rd.
Suite 200
Reston, VA 22090
(703) 478-9350

01/26/87

3000 Ridge Road East
Rochester, New York 14622
(716) 467-7740

9491 Ridgehaven Court
San Diego, CA 92123
(619) 560-4067

Integral Systems, Inc.

Integral Systems is a leading developer of payroll/personnel software for colleges and universities. Its human resources software package accommodates and supports the special and complex administrative requirements of human resources.

Integral Systems representatives welcomed CAUSE86 attendees to their suite exhibit, where product information and literature were available.

Peat Marwick

Integrating Voice and Data Communications

Abstract of a presentation made at CAUSE86

The integration of voice and data networks is an area of considerable interest on campuses throughout the country. This interest is driven by user requirements for greater connectivity, wider bandwidth in transmission, the cost of cable plants, and the need for increased functionality.

Two recent case studies were examined by Peat Marwick in this presentation—Duke University and The Johns Hopkins University. The two integrated network designs employ new technologies and services to meet today's demand for integrated voice and data communications.

Presenters were Robert E. E. Duckett, II, Manager for Peat Marwick, and Norman Sefton, Director of Telecommunications at Duke University.

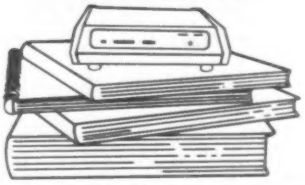
Prime Computer, Inc.

Data Base Technology: Productive Environments

This presentation, given by Joe Gallant of Prime Computer's Product Marketing division, addressed the current interest in data base development and interaction between data base technology and fourth-generation languages. It described the use and evolution of a data base in an administrative setting and detailed the classic elements of a usable data base management system.

Prime Computer, Inc., which develops, manufactures, and markets mini and supermini computers, has over 600 education customers worldwide. In their conference suite exhibit, Prime offered demonstrations of Prime INFORMATION, their Pick-based relational data management product, and Prime CONNECTION, a graphics, word-processing, and spreadsheet application, among others. Company representatives offered information on software products that run on Prime, and colleges that use Prime equipment.

Racal-Vadic



Educational Purchase Program

1525 McCarthy Blvd., Milpitas, California • 95035 (408) 946-2227

HIGH-SPEED DIAL-UP MODEMS—NEW POSSIBILITIES AND NEW QUESTIONS

Scott Porter—**Racal-Vadic**

Overview

A speed migration of dial-up users is occurring in the United States. The demand for higher modem speed is being driven by the increase of PC-to-mainframe connections, new software applications which require lots of data movement, and needed increases in user and network productivity. Applications like data base management systems, full screen editors, and large file transfers are growing rapidly requiring more of the networks' resources while increasing costs. High-speed modems, in particular 9600 bps, are accomplishing given tasks 800% faster than traditional 1200 bps modems.

The increased modem speed lowers user's switched network usage costs, while increasing both user and network overall productivity. Users who are currently spending about $1,000.00 a month on their dial-up networks for file transfer can reduce that bill to $125.00 with the use of 9600 bps modems. Network productivity gains result by accomplishing more data transfers with the same number of modems in a given amount of time.

Recent research conducted among dial-up modem users indicated 45% of the respondents thought 9600 bps was the optimum dial-up speed. In addition, the study showed that current 1200 bps modem users were less satisfied with their dial-up access than were 2400 bps users, indicating higher speed modems give users greater satisfaction.

Technical Discussion

For a network manager to understand the competing technologies at 9600 bps, an understanding of the two CCITT international standards for 9600 bps operation is necessary. These two standards are CCITT V.29 and CCITT V.32.

V.29 technology can transmit or receive in one direction at a time on the public switched network, therefore, it is half duplex. V.32 on the other hand, is full duplex because it can simultaneously transmit and receive. Full duplex is accomplished by transmitting and receiving over the same frequencies at the same time. This works successfully due to a technique called echo cancellation.

Echo cancellation is necessary because the signal being received by the receiving modem is comprised of three components. First, the far end transmit signal energy; second, the local end transmit energy; and third, the level end transmit echo energy. The receiver has to take all the energy that is being received and subtract out the local end transmit and transmit echo. The energy that is left is the far end transmit signal. Modems that are capable of doing this are very complex and expensive devices. In fact, each modem is $3,500—almost twice the cost of a personal computer.

Modem manufacturers have realized that V.32 modems will not be sold into the personal computer and terminal markets for many years to come because V.32 modems are expensive and because terminals and personal computers don't really send and receive files at the same time. Thus, echo cancellation technology is purchased but not used. However, modem manufacturers also realize that modem users want to increase their dial-up speeds. So, the modem manufacturers have come up with a solution which combines low cost V.29 technology with buffer management to provide high throughput, low cost, pseudo full-duplex modems. These modems today cost approximately $1,500.00, and you will see about a 20-25% per year price decrease in these modems over the next three years. In 1989 these modems will cost approximately $700.00.

9600 Applications

The applications for these new asynchronous 9600 bps modems that use V.29 technology are the following: on-line full screen editors, data base management systems inquiry and entry, and of course, file transfer applications. These applications move large amounts of data to and from the remote site so a speed increase shortens the time the job requires, thereby increasing productivity and cost savings.

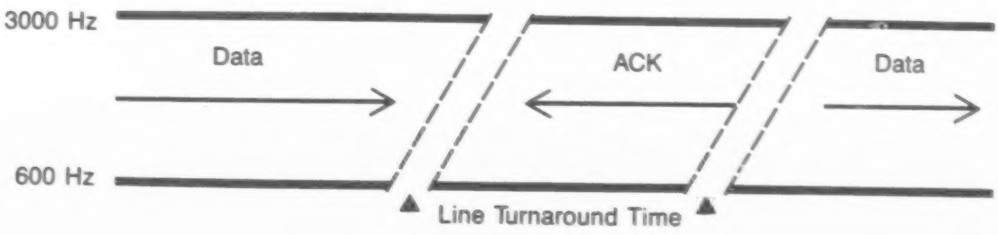
These 9600 bps modems connect to hardware devices such as data terminal switches, local area network servers, minicomputers, protocol converters for asynchronous access into a synchronous environment, personal computers, ASCII terminals, and graphics and data processing workstations.

Asynchronous 9600 bps Protocols

Manufacturers have designed modems to fit in the above applications using various techniques. These techniques are referred to as protocols. It is really the various protocols that make the new asynchronous 9600 bps modems work, not the basic V.29 technology. As such, each protocol has subtleties which affect the user. There are three basic types of protocols.

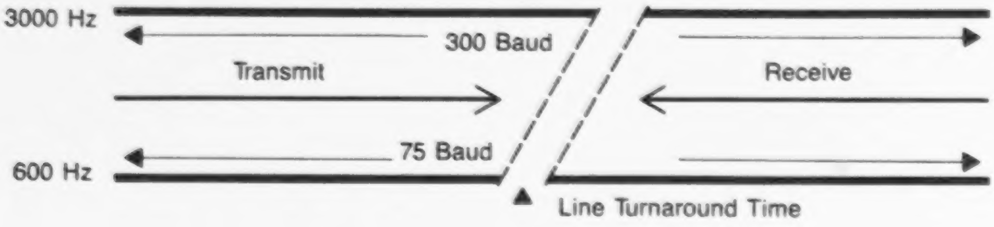
One is a half-duplex ping-pong protocol which provides only one carrier in the direction the data needs to be sent. The line then needs to be reversed so the error control acknowledgment or any other reverse direction data can be returned. The line is then reversed again for more data to flow. The half-duplex channel ping-pongs back and forth to simulate a full-duplex channel.

--Ping Pong



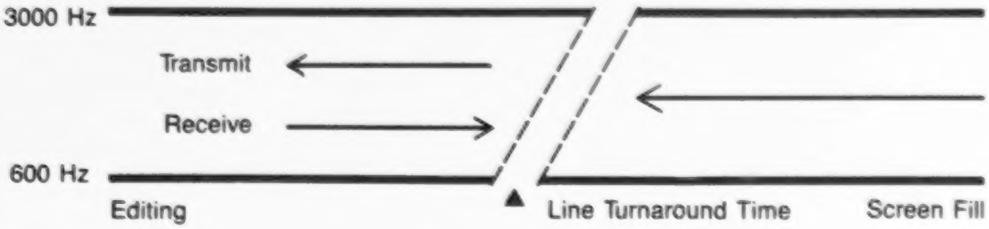
The second technique is half duplex with a low-speed reverse channel. With this technique you have a primary transmit channel in the direction with the most data to send and a reverse channel to bring back the error control acknowledgment or reverse direction data. The main transmit channel changes directions depending on the direction of the greatest data flow.

--Half Duplex with Reverse Channel



The third approach is **Racal-Vadic's** technique called Dynamic Duplex™. This technique marries a half-duplex transmission channel when there is a large amount of data to send to a true full-duplex lower speed transmission technique when small data packets are going back and forth as in a conversational editing session.

--Dynamic Duplex



The technical discussion above shows the three different ways 9600 bps asynchronous operation is achieved. These various protocols or methods affect user applications in different ways.

Technology Impact on Applications

There are basically four different types of user applications. The four different types of applications are: one-way file transfer application (the most common PC method), a small packet one-way file transfer application (XMODEM, Kermit, etc.), two-way (simultaneous) file transfer, and a full screen editing application. Two-way file transfer is a rare occurrence in today's communications world. One-way file transfer application would be a continuous file transfer from point A to point B. The small packet file transfer would be like using XMODEM, Kermit, or similar end-to-end error control protocol. These packages do error checking in software. They only let one packet be transmitted before requiring an acknowledgment from the receiving side. The two-way (simultaneous) file transfer would be sending file X while receiving file Y at the same time. Full screen editing is where you have a remote programmer receiving a screen of data (1920 bytes) while doing some conversational work before getting the next screen of data.

The Dynamic Duplex protocol works well for one-way file transfers and full screen editing. Applications it is not well suited for are small packet file transfers or simultaneous file transfers. The ping-pong protocol works well for one-way file transfer but does not work well for full screen editing, small packet file transfers, or simultaneous file transfers. Half duplex with reverse channel works well for one-way file transfers and full screen editing. Applications it does not work well for are small packet transfers and two-way file transfers.

	One-Way File XFER	Small Packet XFER	Two-Way File XFER	Full Screen Editing
Dynamic Duplex	Good	No	No	Good
Ping Pong	Good	No	No	No
Half Duplex with Reverse Channel	Good	No	No	Good

Different manufacturers have implemented different 9600 bps protocols in their modems. **Racal-Vadic** invented the Dynamic Duplex technique. Telebit, Microcom, UDS, and Electronic Vaults have implemented half-duplex ping-pong protocols. Adcomm and U.S. Robotics have implemented half-duplex high-speed channels with a low-speed reverse channel. Adcomm has a 75 bps reverse channel around 400 hertz, and U.S. Robotics has 300 bps reverse channel around 2900 hertz.

Network manager's need to understand user's applications so they can purchase the right 9600 bps asynchronous modem. The proper modem in the right application will tremendously increase the user's productivity. However, the wrong modem in a given application will be a waste of money and create only problems for its users and those who support him.

For Information Contact:

Joe Sasek
A.E. Educational Purchase Program
Racal-Vadic
1525 McCarthy Blvd.
Milpitas, CA 95035
(408) 946-2227

Racal-Vadic
Dynamic Duplex is a trademark of **Racal-Vadic**.

Great Valley Corporate Center
Four Country View Road
Malvern, PA 19355

215 647 5930

SCT

CAUSE86 - SCT's Participation and Presentations

At CAUSE86, SCT unveiled some of the most exciting new products in its history -- products that can help higher education information service professionals take advantage of the converging technologies discussed at this year's conference.

SCT unveiled these products at its Systems Integration Center -- a unique consultation and demonstration facility established specifically for CAUSE. At the Center, conference participants could schedule for private sessions that offered hands-on demonstrations of these innovative product developments:

- An intelligent, integrated workstation that answers the challenges faced by today's colleges and universities: how to integrate applications that currently are on separate - and often incompatible - mainframe systems; how to easily access strategic information from those systems and their data bases to support critical management needs; and how to achieve integration while protecting an investment on existing systems when budgets are constrained. SCT demonstrated how it can help colleges and universities transform their diverse mainframe applications and data bases into accessible, easy-to-use information resources that harness the power of their computing systems.
- SYMMETRY Series - a new series of advanced administrative and management information software that combines SCT's proven software products - student, financial and human resource applications - with the power of SUPRA, the relational DBMS from CINCOM. SCT demonstrated how SYMMETRY uses proven fourth-generation application tools that permit fast and easy development of new applications and enhancements, and how the prototyping capabilities and a full-function development language help to support efficient production performance.
- A complete line of telecommunications services - SCT's vendor track presentation included an unveiling of seven new telecommunications services, including Master

Plan, Systems Analysis and Design, Integrated Network Services, Systems Procurement, Value-added Services, Implementation Project Management and Telecommunications Resource Management. These services are available individually or in any combination, tailored to meet the needs of a particular college or university.

Other topics of interest presented during the vendor track supported the conference theme "The Impact of Converging Information Technologies". SCT presented various new and innovative solutions as well as new developments designed to help colleges and universities meet today's challenges.

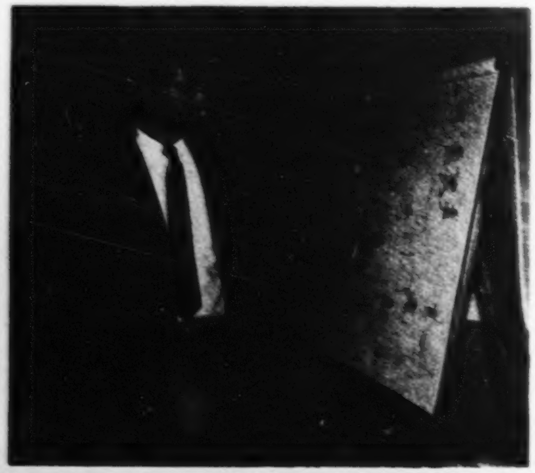
During scheduled hours, SCT invited conference participants to its hospitality suite for refreshments and informal conversation on particular information systems needs. SCT also hosted a "working" dinner where guests were invited to discuss the latest issues in converging information technologies.

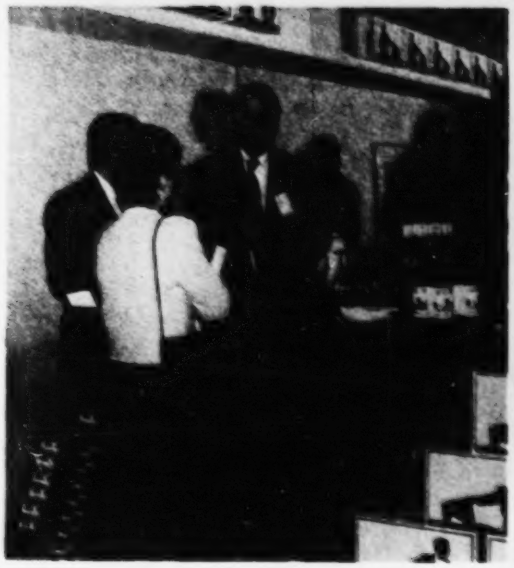
During the conference, the 1986 CAUSE/EFFECT Contributor of the Year Award was presented to Albert LeDuc, Director of Computer Services Planning and Analysis at Miami-Dade Community College, for his article on "Why Planning Doesn't (Always) Fulfill Expectations". SCT was the sponsor of this award.

For additional information, contact Dr. E. Michael Staman at 215-647-5930.

SUITE EXHIBITS

The CAUSE National Conference has always offered individual vendor suite exhibits rather than an exhibition hall for the display of vendor products. Vendors have supported the decision, in spite of the extra effort and expense involved in setting up and publicizing individual suite exhibits, because they appreciate the informality and individuality that the format offers. Vendors offering suite exhibits at CAUSE86 were: American Management Systems, Inc.; Apple Computer, Inc.; AT&T Conversant Systems; Business Systems Resources, Inc.; Cincom Systems, Inc.; Compression Labs, Inc.; Control Data Corporation; Cullinet Software, Inc.; Datatel Minicomputer Company; Digital Equipment Corporation; IBM Corporation; Information Associates; Integral Systems, Inc.; Prime Computer, Inc.; Racal-Vadic; and Systems &Computer Technology.

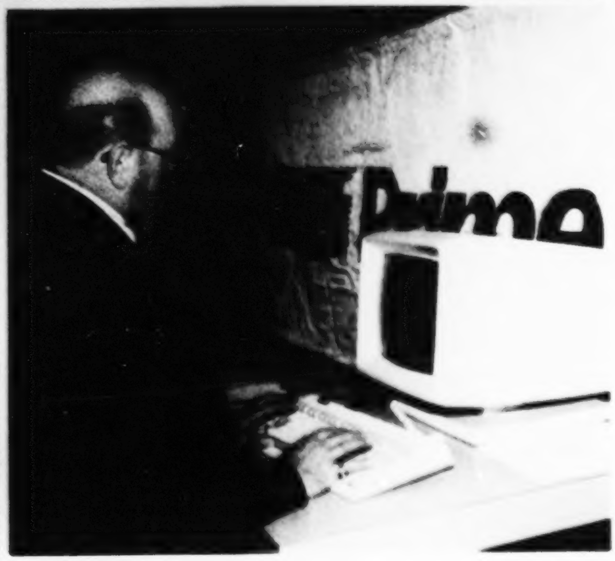




CAUSE
Cause '86
COMMUNICA
CENTE

SUITE EXHIBITS

SCT
SCT SYSTEMS INTEGRATION CENTER
SCT



YOU *CAN* MIX BUSINESS AND PLEASURE

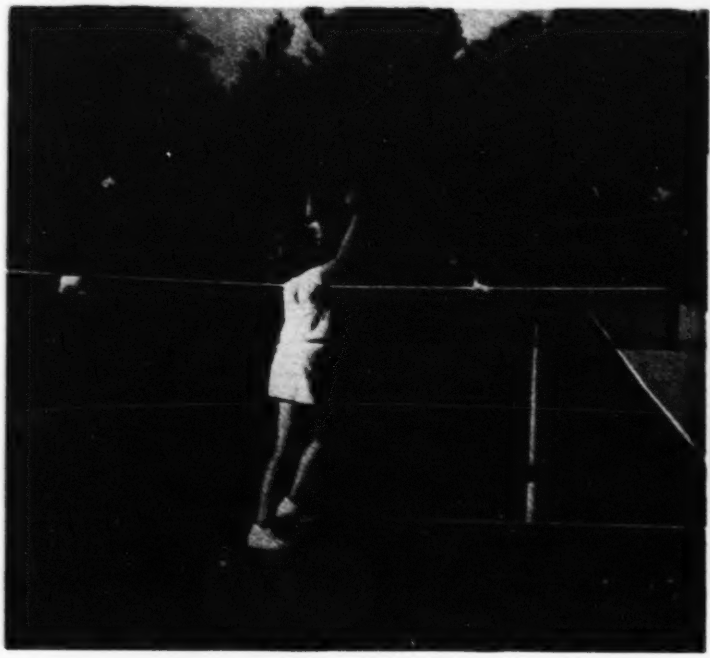
Evaluations turned in by CAUSE86 participants ranked the opportunity to talk informally with colleagues second only to track sessions. There is no question that an important part of the conference experience is the personal contact– scheduled social events like the Registration Reception and the luncheons, as well as informal meetings on elevators or at casual dinners, when new friendships are formed and old acquaintances renewed.

CAUSE86 featured two special activities in addition to the Registration Reception (sponsored by **Digital Equipment Corporation**) to welcome conference participants: a golf tournament on the prestigious Del Monte Golf Course sponsored by **Information Associates**, and the round robin CAUSE86 tennis tournament sponsored by **Peat Marwick** on the Hyatt Regency Courts. Participation was high and so was enthusiasm.

Outstanding theme decorations created by the Hyatt staff made Occasions of even the continental breakfasts and coffee breaks. Thursday night's dinner-dance, "Monterey Fiesta," featured piñatas, strolling mariachis, and the kidnapping of a member of the CAUSE Board of Directors by a gang of desperados– along with a slide show of the athletic talents demonstrated by conference participants during the tennis and golf tournaments and the awarding of prizes to the winners, the United Airlines raffle of two free round-trip tickets, recognition of retiring CAUSE committee members, and an evening of dancing.

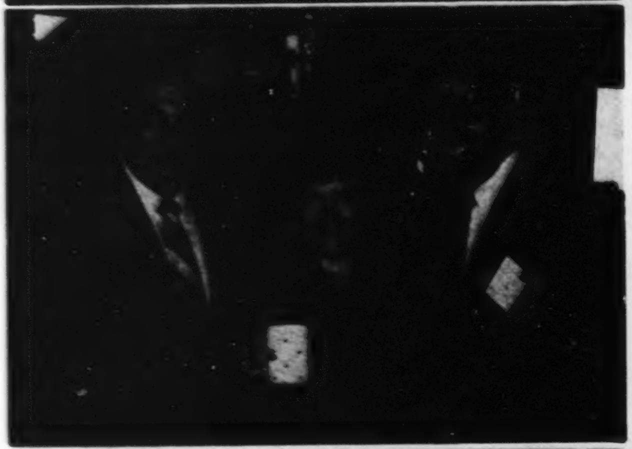
Special thanks to the vendors who sponsored refreshment breaks and continental breakfasts: **American Management Systems**, **Apple Computer**, **Business Information Technology**, **Control Data Corporation**, **Coopers & Lybrand**, and **Integral Systems**.

The pictures on the following pages will let you re-live some of the outstanding moments of CAUSE86...



CAUSE86

CAUSE86



CAUSE86

REFRESHMENT BREAK
COSPONSORED BY
CONTROL
DATA CORP.
AND INTEGRA
SYSTEMS, IN

CAUSE86

CAUSE86